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EDITORIAL

Canning

ALL England is a garden, or so our poets sing. Some grow roses, others apples: horticulture, once a hobby, has become an industry in so far as the stocking of our gardens is concerned. In its more diversified form, the growing of fruits and vegetables, there is a new outlook in horticulture to-day largely due to the discovery of new ways of doing old things. The stimulus to action has been a political one, a tariff, but the restriction of imports resulting has given our chemists the opportunity to show their skill in the processing of British fruit and vegetables. Admittedly the best in the world when eaten freshly picked, the problem is to put these British fruits and vegetables unimpaired in quality on our dinner tables in the cities. The problems of transportation, storage, and ripening are under study; the new home canning industry grows apace. Whilst there are still those who eschew tinned foods, the public at large are rapidly gaining the experience that some of these are highly desirable and it is clear that, provided the ideal of high quality is maintained, there is a great opportunity for the British canning industry to become large and profitable. Its growth has been already rapid: twenty-eight million cans in 1929, one hundred and forty million cans last year, and no doubt many more this season. Mr. George Cadbury has pointed out that this rate of growth cannot continue for the moment and there must now be a halt if we wish to avoid a loss of profit. The industry has had to overcome a large number of technical difficulties. Special research is required to discover the best types of any particular fruits for canning and to produce those products most cheaply; work in this direction is being successfully carried on at the East Malling Research Station in Kent. Some plums are definitely unsuitable for preserving, others can be rendered satisfactory by treatment of the soil: fertilizers have a definite action on the better keeping. The research done on the manufacturing side of canning is of the normal chemical type, if we may use such an expression; suitability of water, that elusive material, affords problems shared with beer and biscuits, and there are numerous conundrums connected with the container. The need for the preservation of the fruit, from the moment of picking it until the factory is able to deal with it, a period which during the busy season it is important to extend, has brought a special series of difficulties into prominence. Pioneer work in this direction is being done in particular by Mr. T. N. Morris of the D.S.I.R. Low Temperature Research at Cambridge. We believe that few movements initiated by our Society have been more pregnant with significance for future progress than the formation of the Food Group. As it is, beginning properly with bread and milk, there is no doubt that its activities will spread to meat and pudding including vegetables and fruits, so that in a generation or more hence, however much we may err in other respects, at least our dietary may be blameless. The square meal, which forms the basis of the Plimmer System so ably expounded in their little book "Food, Health, Vitamins," will have the guarantee of the chemist behind it and specious advertising will have become unnecessary. Happily the tabloid meal becomes more visionary; quality and always quality has become our goal.

The Water Tetrahedron

It is commonplace to regard water as one of the simplest of the substances which a chemist handles; a liquid of which the properties have been so closely studied from so many points of view that we feel we are on the most familiar terms with it and really understand its constitution and behaviour. If we are a little surprised to find that its sulphur analogue, hydrogen sulphide, is so different in physical character we have contented ourselves with the assumption that the association of water molecules to form aggregates—in other words that water is not H_2O but $(H_2O)_n$—suffices to explain away our difficulties. Now Prof. R. H. Fowler and Mr. J. D. Bernal, in a note on the pseudo-crystalline structure of water published in the report of the Faraday Society's discussion in April last on "Liquid Crystals and Anisotropic Melts" (12s. 6d.), recommend us to modernize our ideas on this subject. "The more water is studied," they say in their introductory paragraph, "the more anomalous do its physical properties appear"; whereupon they proceed "Not only that, but the very existence of water is itself anomalous." The chemist is content to accept the anomaly provided he has the water, but he is perhaps

somewhat unprepared for the declaration that the physical properties of a liquid, quite as much as a crystal, must be sought in the geometrical and physical relations between its constituent molecules, atoms, or ions. Nevertheless such indeed appears to be the case. The new "water-theory" is based on two facts. First, that water is not an ideal close-packed liquid like mercury or liquid methane, as can be proved by a study of the curve of X-ray diffraction of water, and as accords with the actual viscosity, compressibility, latent heat of evaporation, and other physical properties of water. Second, that the water molecule is known to be asymmetrical. Now, calculation of the charge distribution indicates that these asymmetrical molecules must arrange themselves tetrahedrally, as in ice, but not necessarily as in ice, for variations are possible. In cristobalite, tridymite, and quartz the SiO_4 groups are in each case tetrahedrally co-ordinated; and although ice is isomorphous with tridymite, water is considered to be derived from the quartz structure rather than to be merely disordered ice. However, the X-ray diffraction curve of water tends at high temperatures to approach that of an ideal liquid, and at low temperatures to approach the ice-like arrangement.. Prof. Fowler and Mr. Bernal therefore present us with a picture of water "as possessing an internal structure which can pass continuously through three stages: Water I (ice "tridymite"-like, light, viscous) → Water II ("quartz"-like, heavy, semi-viscous) → Water III ("liquid ammonia"-like, light, non-viscous). Under ordinary pressures Water II predominates from 0° to 100°, while Water I only occurs, and then not completely, in super-cooled water, and Water III only between, say, 150° and the critical point." The authors are careful to point out that there is no question of different molecules of I, II, or III: "the nature of water is determined by different geometrical arrangements of the same molecules in small regions of the liquid due to different amounts of molecular movement imposed by the temperature." Having delivered this well-aimed and well-intentioned blow at the integrity of the mere chemist's best friend, they proceed successfully to calculate the internal energy of ice and water from the water molecule model derived from spectra and dipole moments, and then to use the same model to account for the nature of ionic solution, which is considered as producing a change in the "structural temperature" of water depending on the nature of the ions dissolved. Hydrated ions produce on water an effect of tightening and regulating the structure exactly similar to that produced by lowering the temperature, while large non-hydrated ions produce an increase of disorder corresponding to a rise of temperature. But the authors are not content with this new concept, which they hope will be useful in the study of biochemical and physiological problems. They go further in quest of the real nature of the hydrogen ion in solution, and they calculate the energies in water of the ion complexes $O_2H_5^+$ and $O_2H_3^-$, finding that these are only slightly larger than those for $H_2O(H_3O)^+$ and $H_2O(OH)^-$, respectively. In other words, "the potential barrier for a proton moving from one water molecule to another is very small." This leads Prof. Fowler and Mr. Bernal to a theory for the abnormal mobilities of the hydrogen and hydroxyl ions, according to which the ions not only move bodily as do other ions, but also "by a kind of relay race." But the isotopic ion $(H^2)^+$ should have a greatly diminished chance of negotiating the passage from one water molecule to another, and the anomalous mobility should no longer exist. Hence a difference in physical properties of corresponding H^1 and H^2 compounds should be expected if, and only if, the H^1 is one that could take part in a hydrogen bond; that is, chiefly in acids and alkalis, and not in substances like methane. In a preliminary experiment with $H^1{}_2SO_4$ and $H^2{}_2SO_4$ no difference greater than 20° could be observed between the boiling points, but since only one milligram of $H^2{}_2SO_4$ was available the question can hardly be regarded as settled, and we look forward with great interest to a further report when a larger quantity of material is forthcoming. If this note leads others to read the paper in question, and perhaps also to study the fuller account to be published in the *Journal of Chemical Physics*, we shall feel that no apology is needed for our unashamed publication of an abstract of a scientific paper in columns which are generally supposed to be reserved for cameos from the editor's mind-picture. In point of fact the contemplation of water in a new guise fascinated him to the momentary exclusion of other things, and to him in the future a glass of water will ever hold a new and unsuspected charm.

A Thousand Shops

The firm of Boots is but fifty years old, yet it is old enough to have one thousand branches, the newest of which, at Galashiels, was opened on Thursday, October 19. The ceremony was appropriately performed by Florence, Lady Trent, who pressed a button in London to open the door in Scotland—the wireless doing the rest. At the ceremony Lord Trent made appropriate reference to the history of the firm which to-day has seventeen thousand employees and serves one hundred and thirty-five million customers a year. Lord Leverhulme, speaking with his usual felicity, paid a tribute to the memory of the great founder of the firm, always so ably aided by his wife, whose aim to bring the best drugs and medicines within the reach of the people of the country had been so fully attained. We chemists, whilst giving our congratulations to the firm for their success in building up the retail side of the business, are not unmindful of its achievements as chemical manufacturers and pioneers in chemical research. The magnificent factory at Beeston, opened as part of the celebrations of the Jubilee of the firm, is both an architectural feature and the last word as a productive unit. We recall the achievements of the Boots laboratories during and after the war when under the charge of Dr. Carr and Dr. Jordan, citing only the production of saccharin. To-day, under the leadership of Dr. F. L. Pyman and his staff, the laboratory proceeds from triumph to triumph in the manufacture of useful therapeutical products so that this country is fully abreast of the times in the home production of medicinal chemicals. The combination of manufacturer and retailer is an ideal one, though unusual. Happily this year also has seen the ownership of the company return to England; the Jubilee year has been one of great events.

CANNING FRUIT AND VEGETABLES*

By GEORGE CADBURY

The English canning industry has been much in the public eye during the last few years, and it has struck the imagination of the public because it seemed to open out new possibilities for agriculture and for the development of a new industry in the country, replacing foreign imported foods by home-grown products.

The growth of the industry is shown by the figures of the last five years, which show a phenomenal development, the output in 1927 being estimated at 7,840,000 cans of fruit and vegetables, which has been increased until 1932, when it is estimated that 50,000,000 cans were produced. This is only a rough estimate as there are no definite figures available. The imports of canned fruits and vegetables have increased in volume by 15% during this period although the value of these imports has decreased by 10% during this period. As a result, the anticipated benefit both to agriculture and to the industry itself has not been as great as was at first hoped. This is due to several reasons, among the principal ones being over-stimulation and consequent over-production, and the phenomenal fall in prices of imported canned goods both from the Dominions and from other countries in spite of tariffs.

The tinplate industry and the can-making industry have both been very active in promoting the progress of canning, and they have been backed by the Board of Agriculture who, naturally, have been anxious to foster the consumption of fruit and vegetables for this purpose. The consequence of this development has been firstly a shortage of suitable fruit and vegetables which put up the prices of raw materials, and secondly a tremendous unloading of surplus stocks on the market, both home produced and foreign, which has meant sales at uneconomic prices. I need not follow this line of discussion further, but I thought it necessary to begin with the general outline of the chain of events in this country so as to make it clear that further erection of plant and machinery is unlikely and inadvisable during the next year or two.

Theory of Preserving Foods

The problem of conserving our food supplies from one year to the next has always been a problem for mankind, and indeed for many animals as well. Some kinds of foods will keep satisfactorily by being stored in a cool dry place, such as certain fruits as apples and pears, and corn, while others will keep after being dried in the sun, as raisins. Other kinds of foods can be preserved with salt, hence the great demand for salt for preserving meat and fish in the middle ages.

With the progress of science, still other methods have been evolved, and perhaps the most recent are the preservation by heat treatment in closed vessels, such as bottling and canning, or by refrigeration; this latter method being only in its infancy, I propose to deal only with canning, especially from the processing side.

In dealing with the question of food preservation, we must first of all enquire as to what are the causes of spoilage, and these will in the main be found to be bacteriological, fermentation, and the growth of moulds. Other causes are more purely chemical, such as internal breakdown of the fruits and the action of fruit acids on the metal container. Sugar has been used in the preservation of fruit in large quantities ever since its introduction, and salt for vegetables and meats. Both these methods, however, alter the flavour and character of the foods preserved, and many of the vital health-giving properties of the foods are destroyed. The process of preserving foods in a closed vessel not only conserves the flavour, which in many cases is very volatile, but also preserves those vitally important bodies, the vitamins, which are only destroyed to a slight extent by heat, and mainly by oxidation. Vitamins C and A are the vitamins mainly found in fruit and vegetables. The process of cooking in a closed vessel, almost free from the presence of oxygen, conserves the vitamins in a remarkable way, and I think it might be said that canned fruits served on the table probably preserve their flavour and health-giving factors better than the ordinary house-wife's stewed fruit, which has been cooked in the open and not under the same exact control as is exercised in a canning factory.

In essentials, the process of canning consists of placing selected fruits and vegetables in a metal can either in syrup or water or brine, hermetically sealing the container, and heating it to such a degree as to sterilize the contents. The process sounds simple, and so it is, and yet the technique of canning is full of pitfalls, and requires great skill and many years of training to produce a perfect stable product.

The Container

The first essential is to get suitable cans in which to preserve the fruit. These are now made in this country by automatic machinery, much of which is imported from the United States. The tin plate is coated with a double layer of lacquer, which has been specially devised for this purpose, stoved, and then passed through the can-making plant which automatically produces an air-tight can with a rubber joint round the bottom and a soldered joint among the seam. The tin plating, of course, has been done as perfectly as possible so as to cover the whole of the steel, and the lacquering gives a further protective layer which is impervious to the action of fruit acids. In the ordinary unlacquered can these fruit acids slowly act on the tin, and if there are pin holes, more quickly on the steel, with the result that hydrogen is evolved and the tin dissolved by the acid, which not only is objectionable in itself from a health point of view, but discolours the liquid and bleaches the fruit. Every effort is made, therefore, to get the lacquering as perfect as possible, but even the most perfect process is liable to have faults, either pin-holes, or the lacquer cracks where the can is bent. For this reason the system of stamping lids by impressing code marks on them has been generally given up, as it is found that the lacquer inevitably cracks at the edges of these code marks, and the contents are rapidly destroyed. Another curious phenomenon has been discovered, in that single lacquering is less effective than no lacquer or double lacquer as the defects are more pronounced with single lacquering, and the chemical

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action seems to be concentrated on exposed points, with the result that the action is intensified and the tin destroyed more rapidly, and the steel more quickly exposed, when of course, pitting takes place and the can is destroyed.

Cans used for preserving vegetables are treated differently, as in this case the danger arises from sulphur compounds instead of from acids. The tin or ordinary lacquer would therefore turn black and look most unsightly, and a special sulphur resisting lacquer containing zinc has been devised, which does not discolour with the presence of sulphur compounds.

Fruit Canning

After years of research, both in America and in this country, the technique has been perfected, and it has been found essential: (a) to exhaust the fruit first in the open can; (b) to seal; (c) to cook to an exactly predetermined point both as to temperature and time, which differ for each fruit, and for various quantities and kinds of each fruit.

This is the technique of canning, and has only been perfected by long experience.

Only certain kinds of each fruit are suitable for canning, and then the quality must be carefully selected and graded, the residue going to pulp for jam making. The fruit is then placed in the can with as little handling as possible, syrup is put in, in a syruping machine, and then the can is put through the exhaust box. This consists of a water bath or steam-heated chamber, and the cans are kept in the bath at a certain temperature long enough for all the air to be expelled from the interstices of the fruit. This is vitally important for the proper preservation of the fruit, so that: (a) no air is left in, which might oxidize the vitamins and damage the flavour, (b) the syrup can penetrate to all parts of the fruit and preserve and mellow the flavour, (c) the contents of the can are raised in temperature before closing, so that there should be a high vacuum inside after the complete process owing to the fact that the air has been expelled so that the fruit may be cooked more evenly at a higher temperature and for a shorter time.

The can is now passed through a seaming machine, when the lids are spun on at high speed, from 30 to 100 per minute, depending on the type of machine employed. The cans are now passed through the cooker, which may be a tank of boiling water in which they are immersed in baskets, or a continuous cooking machine on a rotating path in water kept at an exact temperature by a thermostat. The cans are then passed through a cooler to stop the cooking process, and turned out into the store.

The amount of mechanization of all the processes varies from the simplest plant, consisting of tanks of boiling water and a hand-operated seaming machine, called a Home Canning set, to a fully automatic line in which the cans pass automatically from process to process, not being handled from the time they are filled with fruit till the time they are sent rolling down the chute into the stores below.

As may be expected, the most highly-developed plants come from America, the home of large-scale canning, but other successful plants are made in France and Germany, and now during the last few years in this country, based however, almost entirely on American practice.

I will now describe more in detail the actual plant used in a typical cannery. It is, of course, important that the fruit should be preserved whole and should be able to stand a considerable amount of vibration in transit. Not only must the fruit be thoroughly sound and not too ripe when canned, but it must be penetrated by syrup of sufficient density to mellow the whole fruit and give it firmness. On the one hand, too heavy syrup makes the fruit liable to collapse, while too light a syrup may cause early pulping and the final density may not enable the fruit to retain its structure. It will be realized that during the process of maturing, an interchange is taking place between the syrup and the juice contained in the fruit. This interchange has no effect upon the density of the syrup used and the ripeness of the fruit, and the final density is no criterion of the sugar originally used.

It will be frequently noticed that when a can is opened it appears to be only half full of fruit, especially such juicy fruits as strawberries. It is impossible to make it fuller than this because the cans are filled with as much as they can hold when originally placed on the belt, but by this process of interchange the fruit gradually shrinks, the usual shrinkage of fruits varying from about 25% to 40%. The syrup, therefore, ultimately contains a very great deal of the essential flavour of the fruit, and should not be thrown away, as it contains very valuable properties, and what is left over can usefully be made into jellies and other confections. The stable condition is generally reached in two to three weeks—some fruits longer and some shorter, according to the thickness of the surrounding skin.

The Canning Process

Successful fruit canning is primarily dependent on the proper selection of raw fruit. This entails proper cultivation, selection of varieties suitable for canning, and a very rigid control of picking so that the fruit arrives at the plant in condition for canning. Fruit suitable for canning must be picked when it has reached maturity but is not over-ripe as it could be if it were to be used fresh for the table. At the same time, it must not be under-ripe, as the colour, texture, and flavour would make it unfit for canning if a high quality product was wanted. It must be remembered that all fruit must be handled and shipped several times after canning, so gathering at the proper stage of maturity is imperative if the appearance of the finished product is to be maintained without causing a breaking down of the tissues. To preserve both flavour and appearance, the fruit is picked into small chips or baskets, holding from 1 to 6 lb. of fruit, depending on the variety or softness of the fruit itself, and then delivered to the factory within a few hours from the time it has been picked. Thus all fruit is picked and packed the same day, before any of the delicate flavours can be lost or the appearance spoiled, or before any enzymic action can take place. The chips are brought into the plant and the fruit placed on moving

belts, where women operators remove all defective fruit. This defective fruit is afterwards cleaned and used for making jam. After this careful inspection, the sound fruit is carried through sprays of water, where all adhering dirt and foreign material are removed. After washing, the fruit continues its journey and is carefully graded for both size and maturity. To ensure that each can is uniform in appearance, size of the fruit, texture, and flavour, it is absolutely necessary that the berries or other types of fruit going into each can be perfectly uniform in every respect. This operation in any properly conducted and well-controlled cannery is successfully carried out under rigid supervision, so that when the consumer purchases a can of fruit she can be reasonably assured of receiving a can of fruit graded uniformly for size, texture, colour, and maturity.

After carefully grading the fruit, it is placed in the cans, all large fruit going into large cans, while the small fruit is usually placed in small cans. As the cans are placed on another moving belt after filling, they pass before a supervisor, who checks the cans for weight so that the consumer is assured of a uniform content. The supervisor also watches to see that each can is as nearly perfect as possible in every respect before it enters the next step of manufacture; therefore, each can is filled as full as possible, consistent with the maintenance of quality. As the cans leave the filling table, they pass into a syruper where they travel in a circle under a revolving tank with valves in it, and as the cans go around, they lift the valves which discharge the syrup into the cans so that each can receives a uniform amount. The syrup used varies, depending on the maturity and variety of the fruit, but is a sugar and water combination testing from 40 to 55° Brix. Following the processing, which will be described later, the natural juices from the fruit begin to equalize with the syrup until such a time as a stable position is reached, usually in a period of two weeks, except in the case of some extremely tart fruits such as gooseberries, where the process of equalizing and "mellowing" may go on for a year or more. After this period of "mellowing," the fruits are ready for distribution.

Some special device is usually incorporated into the syruper to insure this accuracy, as a definite amount of headspace is required to allow for the expansion of the products during sterilization, for the evolution of any gases formed during sterilization, and to allow a margin of safety, in case the process has not been correctly carried out, against the formation of hydrogen gas. The cans then travel to an exhaust box which is usually a rectangular tank filled with water and through which the cans are conveyed in a continuous motion by a series of discs. Each exhauster has some means of varying the speed as well as the temperature so that each product may receive only the proper amount of pre-heating to ensure proper vacuum, to remove all air from the can so that vitamins will not be destroyed, and to assist in rapid heat penetration during sterilization without injuring in any way the quality of the fruit itself. The cans feed from the exhaust box into the seaming machine, a high-speed horizontal mandrel which rolls or spins the lids on to the cans, the joint being rendered air- and steam-tight by a ring rubber deposited in the outer edge of the lid. These machines are on the "no can, no lid" principle, so that the lid feed only operates when a can passes on and releases it from the pile.

After seaming, the cans roll down a runaway into the cooker. The cooker is usually an oblong box in which a horizontal spindle slowly revolves and carries the cans through the spiral from one end to the point of discharge. During this period, the cans are immersed for a third of the time in water, which is maintained at a constant temperature. At intervals, along the side of the machine, are discharge doors making possible variations in the length of the cook which is dependent on the variety and maturity of the product going through the machine. The water is heated to temperatures ranging from 180° to 205° F., which vary according to the relationship maintained between the temperature of the exhaust and temperature at time of seaming, and the subsequent rapidity of heat penetration which will adjust the length and temperature of the cook so that a perfect degree of sterility is attained. The various fruits have minimum temperatures at which the various spore-bearing bacteria will be either destroyed or rendered inactive, which is generally estimated to be a minimum of 165° F., although of course to ensure safety, a slightly higher temperature is always reached. The excessive acidity of fruit makes sterilization at high temperatures unnecessary.

The cans then pass into the cooler which is a duplicate of the cooker, travelling by a long spiral path in a tank of cold water. Part of the path of the spiral is exposed and cold water sprays are played on the cans at this point as this insures more rapid cooling. The object of the cooler is to cool the contents of the can quickly to prevent further cooking and any subsequent disintegration due to having been exposed to heat for a long period of time. Likewise quick cooling prevents the growth of any types of heat-resistant bacteria that might grow in any fruits of low acidity.

From the cooler, the cans are checked through an automatic counter on to the conveyor and taken to the casing machine in which they are cased, if they are to be stored in cases, or to the stock room where they are stacked on end, each layer being separated by stacking boards. From a keeping point of view it is desirable to place the cans in stacks with sufficient space between to allow for ventilation, rather than in cases. It is very usual to keep cans in the store room three weeks to see if they are liable to ferment or to blow through imperfect joints. After this time the probability is that the cans will keep sound for many months.

Problems of Fruit Canning

There are two sources of trouble which may occur. The first is fermentation, which generates carbonic acid gas which in time bulges the can and eventually bursts it. This is easily corrected by accurate processing. The other is what is known as "hydrogen swells," when acid from the fruit acts on the can itself. The process is very slow, especially in cool temperatures; it very rapidly accelerates as the temperature increases

to about 70°. "Headspace" is always left in the can so as to allow a certain amount of hydrogen swell, which in itself is perfectly harmless and nearly always takes place. It is kept at a minimum by the best obtainable lacquering and cool storage.

Canning Fresh Peas

Vegetable canning is highly specialized and the equipment and methods are quite different from those employed in fruit canning, arising from the fact that vegetables are not acid like fruits and therefore have to be sterilized at high temperatures.

For a one-line plant which will handle from 350 to 400 acres of peas, the following equipment is used: 2 podders, 1 clipper cleaner, 1 cylindrical washer, 1 blancher, 1 shaker washer, 1 picking table, 1 filling machine, 1 closing machine, and 6 retorts in which the products are cooked under pressure. These retorts are usually equipped for cooling, but if not, an additional cooling tank is needed.

It is necessary for the water used in canning peas, or any other products, to be adequate and pure. The water should be free from any appreciable amount of organic material, obnoxious odour and taste such as sulphur and salt, and should be neither alkaline nor too hard, and the water used in washing, blanching, and syruping or brine making should be potable. The presence of sulphur or salty taste will affect the finished goods and will very likely cause great discoloration or hardening as well as an obnoxious odour. If the water is too alkaline the product may become disintegrated (or mushy), while if too hard it will harden the vegetables, often making them difficult to process and thus affecting the quality. For the canning of peas, it might be noted that from 4 to 5 gals. of potable water is used for every 20-oz. can of peas produced in a factory, most of this water being used to ensure proper cleaning of the product itself.

Great care is taken to select seed of a type most suitable for canning, as the ordinary varieties of market peas are not suitable for this purpose. Only seed selected by the factory is given to the grower, who is likewise given a schedule showing the land on his farm most suitable for the growing of peas as well as giving him exact dates during which a definite acreage must be planted so that the factory may be assured that the harvesting will ensure uniformity in maturity as far as possible. The varieties most usually grown are the Lincoln or Surprise, which are of the sweet, wrinkled type. As the fields are ready for harvesting, the factory maintains a field staff to advise the grower on the proper time to have his crop picked, and great care is taken to see that peas are picked on the day of their most perfect flavour and canned the same day. Pickers go through the patch and pick the pods from the vines and place them in sacks for conveyance to the factory. The peas in the pod are fed into a shelling machine where the pea itself is removed from the pod by a series of beaters operating in a large horizontal cylinder. These beaters rotate rapidly and beat the pods against perforated metal screens, splitting them open and releasing the peas which drop through the perforations. The pod itself is carried away from the machine and is used for cattle food or for the making of artificial fertilizer.

From the podding machine the peas flow by gravity to some type of cylindrical washer where they are usually treated to both a hot- and cold-water washing process. The hot water is heated to a point varying from 100° to 150° F., dependent on the maturity of the pea itself, and is used for opening the split and broken peas so that they may float on the top of a separator, whereas the solid peas will sink and then be conveyed into the second part of the machine for additional washing, where a great deal of the mucous material adhering to the skin of the peas is removed as well as many of the various types of spore-bearing bacteria.

In some factories the peas are graded into three sizes, the first being from $\frac{9}{32}$ to $\frac{10}{32}$ in. in diameter, the second size being from $\frac{11}{32}$ to $\frac{12}{32}$ in. in diameter, while the large size are any peas over $\frac{12}{32}$ in. in diameter. However, most factories are discontinuing this practice as grading causes bruising of the peas as well as providing a chance for enzymic action to take place. Furthermore, the housewife is accustomed to seeing peas irregular in size as they come "from the pod," and as a result the demand for ungraded peas is growing, which not only improves appearance and flavour, but makes possible more rapid handling of the raw product itself. In case peas are graded, this is done following the first washing operation in a cylinder perforated with holes of the dimensions given, through which the peas pass as they are carried through the machine.

The practice now usually followed is to have the peas flow into the blancher from the washer. The blancher is a long cylinder immersed in a bath of water and through which the peas are carried. The length of the blanch as well as the temperature of the bath itself will of course vary, depending on the variety and maturity of the peas. These temperatures are well controlled at all times so that none of the delicate flavour of the "garden fresh pea" is lost, nor any of the soluble sugars destroyed. The purposes of blanching are: (*a*) to shrink the pea so as to secure a better fill; (*b*) to remove the outside mucous material from the pea, and thus secure a clear liquor as well as eliminating spore-bearing bacteria; (*c*) to lessen the rather strong flavour of the fresh pea; (*d*) to provide a general cleansing method; (*e*) to remove occluded gas from the peas, which if not removed, will produce a low vacuum in processed cans or may cause buckling of the ends during the processing period; (*f*) to cause sufficient absorption in the case of mature peas to obviate their taking up water after canning.

The time varies from 2 up to as high as 15 minutes, while the temperatures vary from 180° to 212° F., based entirely on a critical examination of the raw peas prior to blanching. Excessive blanching is definitely detrimental to the flavour of the finished product and only occurs in factories where the control is inexperienced. During the blanching operation a constant stream of fresh water is added to the machine to ensure cleanliness. After blanching, the peas are again washed as they pass through a shaker washer so that any starch or other foreign material adhering to the peas will be removed prior to the picking operation, which

done by hand on a moving conveyor belt, where any bits of broken pea are removed as well as a final inspection given to see that all are suitable for canning.

From the inspection table the peas pass into the filling machine, where a measured quantity of pea and boiling brine is filled into each can. This machine operates at a speed of 120 cans per minute and is able to measure accurately the amounts of peas and brine going into each can. The brine used to cover the peas is a mixture of sugar, salt, and water. The mixture is varied according to the condition of the raw material, but great care is taken to ensure that each can of the finished product will be exactly uniform. After filling, the cans are conveyed to the seaming machine, where a cover is rolled on the can in the same way as described in fruit canning. Up to this period, it is interesting to note that the peas have been picked and delivered to the factory within a period of from 4 to 6 hours and that from the time of podding until they are in the can and closed, a period sometimes as low as 6 minutes is all that is required to prepare the peas and place them in the can. This speed and use of automatic equipment make possible the preserving of all of the delicate flavours as well as the appearance of the peas themselves, so that a can of peas is usually much richer in vitamin values and finer in flavour than the presumably "fresh peas" sold on the market.

After closing, the cans are placed in wire baskets and conveyed to the retorts which are either horizontal or vertical and able to be hermetically closed so that the processing may be carried on under high pressures, which are essential to destroy the various types of bacteria found in vegetables. The temperatures generally used range from a minimum of 240° to 250° F., while the length of time varies dependent on the size of the container itself, the initial temperature at the time of closing and the subsequent effect it has on the rapidity of heat penetration, and the length of time necessary to kill these bacteria or render them inactive so that they will not, under normal conditions, cause any action during the period of storage prior to consumption.

Some interesting problems are introduced at the retort stage. It will be realized that the can is very nearly full of brine in which are immersed solids such as peas or beans. Raising the temperature of this to 240° F. naturally increases the internal pressure in the can—the larger the size of the can the more difficult the problem of dealing with it becomes. At the end of the cook one has a volume of liquid at approximately 240° F., and if the pressure were suddenly released, the can would either burst or the seams would be so distorted as to leak, and the contents, therefore, would very soon become infected and ferment. It has been very difficult to ascertain what goes on in the can at these temperatures, but for some reason it appears probable that the pressure in the can increases at a greater rate than the pressure in the retort itself at similar temperatures. It is obvious that the cooling down process must be very carefully carried out, and hence the cans are cooled under pressure with cold water so that the period of cooking is stopped, and the development prevented of various types of bacteria such as thermophilic bacteria which remain active if the temperatures are permitted to remain above a certain point even for a short period of time. The introduction of air into the retort at the time of cooling is necessary if the internal and external pressures of the cans are to remain equalized during the time this pressure is being reduced and to prevent collapsing or buckling of the cans to a point where they might leak or at least be unsightly. Furthermore, insufficient cooling may result in cloudy liquor which causes an unpleasant appearance when the can is opened, although this is not one of the primary causes for making cooling necessary.

Various types of continuous-pressure cookers for vegetables have been devised both in this country and in America which, by means of transfer valves, receive the sealed cans, transfer them to the interior of the machine, cook and deliver them over another transfer valve into the pressure cooler and thence by a further transfer valve to the open air. These machines are very ingenious, but it is doubtful how far they are a paying proposition owing to the very short period over which they can be utilized. Another disadvantage is that if a can should jam or break the transfer valve—and the can has yet to be discovered which will not jam—hundreds of pounds' worth of goods may be destroyed by over-cooking during the period of the jam until the contents can be released.

A new type of pressure-cooker and cooler has been developed which is vertical and is much favoured, as it occupies little space, consumes less steam, uses less labour, and ensures exact uniformity in processing and cooling. The machine is fed by a rotary valve so that the cans enter and leave the cooker and cooler through steam-tight valves. The cans are carried upright through the machine so that no shaking of the product occurs and as a result of the continuous movement, it is possible to use a shorter period of time for processing, which improves colour, and at the same time effects perfect sterility. As the cans discharge from the bottom of the cooking chamber, they pass into the cooler where a pressure suitable to prevent distortion of the cans is maintained by use of the column of water itself which maintains a hydraulic pressure so that as the cans move upwards and are being cooled, the pressure externally is being reduced as rapidly as the internal pressure. The machines will not accept cans that are dented or imperfect in shape, and as a result have made possible better operation, and they should provide a means of making impossible any of the variations sometimes encountered by inexperienced process men.

A further source of difficulty with canned vegetables is what is known as "flat sours." This arises from a type of bacteria known as thermophilic, which has the curious property of being active only at high temperatures round about 130° F. Consequently, it is in active operation at the time the cans are above this temperature. When the can is cooled, no outward effect is visible, and as fermentation has ceased, no further breaking down of the contents takes place nor generation of gas, and the can is therefore apparently perfectly sound, and only when it is opened is it found that the contents have become mushy and sour. The origin of this germ is difficult to trace, and it is generally found to be

esent in sugars which have come from an infected gar factory. Another source of "flat sour" organism the blancher. Small quantities brought down from shelling floor find an excellent breeding ground the blancher, and unless excellent washing and aning processes after each day's run are adopted, blancher is a very likely source of "flat sour" anisms. It is somewhat difficult to get rid of when ce it is introduced into a plant, as steaming the nt, unless extremely effective, is generally of very le use, the only method of dealing with it being an indance of washing with cold water. When a sugar tory or canning factory is infected with this germ, equires the greatest care to eliminate it.

he interior of all cans of peas normally shows more ess discoloration. This is due to sulphur compounds duced from the peas during processing, acting on tin of the can and forming tin sulphide. The ount of this discoloration depends on the variety l maturity of the peas as well as the length and nperatures of the process. Any large factory now vents such discoloration by the use of a lacquered can ch is covered with sulphur-resisting compounds.

Other Vegetables

ubstantially the same process is followed in the paration of other vegetables used for canning. String-beans, beetroot, carrots, spinach, and other miscel-ous vegetables are canned in large quantities in gland. The same great care is taken to select per seeds, to prepare the soil properly and make nite schedules for planting, and to provide adequate rol during harvesting to ensure that the factory is iving only those vegetables picked at the moment 'fleeting flavour." Beans, as well as these other etables, require a great amount of hand labour. for snipping the two ends of the beans and packing the can itself. Beans are delivered to the factory, nediately snipped, graded for size, each can contain-beans of a uniform size, blanched to neutralize colour and remove any mucous material, thoroughly hed, and filled into the cans by hand. After filling, cans are filled with brine and exhausted to ensure proper closing temperature and the exclusion of the container. After exhausting, the cans are ned and placed in the retorts where they are pro-ed and cooled in much the same way as peas. The th and temperatures of course vary, depending he maturity and variety of the beans.

eetroot and carrots are carefully cleaned in auto-ic carborundum cleaners, then pass down a moving veyor table where they are re-inspected by women, remove the last bits of skin and any other foreign erial. From the inspection table the beets and car-are graded for size. The smaller ones are placed the cans whole while the medinm-size beets are d, and the larger beets and carrots are diced into cnbes. After preparing in these various ways, products are placed in the can, usually by hand, covered with a hot brine usually containing a salt solution, exhausted, seamed, and cooked and ed in the retorts.

It will be obvious that there are many different treatments possible to handle the same product, and as we are dealing with nature and her variations, the raw material received from day to day makes necessary constant variations in the entire processing methods to ensure the margin of safety necessary to protect the consumer and at the same time maintain the highest possible quality. This makes necessary a trained technical personnel and as the industry has developed rapidly, it is not always possible to secure men qualified to operate a plant and produce only first-quality goods, but the larger factories now produce them, so as to conform with the requirements of the National Mark Scheme which specifies: (*a*) the condition of the liquor or syrup, (*b*) the extent to which defects are permissible in the appearance of the product, (*c*) the uniformity of size and trueness to type, (*d*) the flavour, (*e*) the tenderness of the product.

These qualities are judged in every lot of canned foods produced and a definite grade is given to each lot by use of a marking system which determines numerically the relationship of each lot to the set standards of the National Mark Scheme. This ensures each housewife that when she purchases a can of fruit or vegetables produced by a canner under a certain brand label, she is assured of a definite standard of quality.

Plant

It will be readily understood by engineers that one of the great problems facing canners is how far it pays to put down elaborate plant for such a short season as we have in this country. Taking an ordinary fruit line, the first fruits which can be utilized are gooseberries and strawberries at the beginning of June; there is then a fairly unbroken run until September, the end of the plum season, when blackberries are over, or October if apples and pears are being processed.

The longest possible run in any season is something like 4½ months, and although the volume passing through is very unequal in quantity during various periods, it is probably true to say that the ordinary canner's plant is not in use for much more than 3 months in the year. The plant therefore has to bear all its overheads for 3 months out of the 12, unless some winter products can be found to utilize the plant—a problem which so far has defeated most canners in this country. Vegetable-canning plant is even more expensive, as while the brining and closing machines and retorts are in use for all vegetables, all other specialized machinery is only in use for a few weeks. The problem arises therefore, as to how far it pays to have really up-to-date labour-saving machinery, with a consequent very heavy standing charge over a large part of the year, or to use rather more expensive labonr, which conld be dispensed with as soon as the season is over. This applies to the whole of the plant in the canning factory, which probably will be shut down entirely for 6 to 8 months in every year. It is obvious that it will not pay to put up expensive buildings with elaborate, up-to-date, efficient boilers and engines, but the first cost of plant must be cut down to the very minimum.

In the same way, there is the difficulty with staff, which expands to a maximum shortly after starting up on the strawberries and gradually is reduced as the season advances, until the plant shuts down completely and only one or two men are required to retain the plant and prepare it for next season's work. A certain staff, of course, must be retained for labelling and despatching. When people discuss the question of putting down a canning plant they are apt to overlook the fact of the short season and the consequent effect on overheads, the difficulties of the labour position (which is so entirely seasonal), and the fact that the plant and equipment are only a fraction of the capital required in running a canning business, as the greater part of the capital is locked up in goods which are all processed and paid for within a few months, and held for disposal over the remainder of the year. Bearing these factors in mind, therefore, it will be seen that the advance of canning machinery must necessarily be slow if such machinery is elaborate and expensive in the first case.

In designing machinery, therefore, not only must the technique of fruit and vegetable canning be thoroughly understood, but the machines must be simple to operate, not liable to jam, and the line must be put up at a low first cost, so as not to involve heavy overheads during the eight or nine dead months of the year.

Canners are constantly on the look-out for the manufacture of products which can be made in the dead season, such as soups etc., but the field for that kind of enterprise is not only limited, but has been exploited to the utmost at almost any price which will cover factory overheads, and until some form of rationalization takes place it will continue to be unremunerative and hardly worth entering upon. Nevertheless, some solution along the lines of the manufacture of winter products which will utilize existing plant and buildings and give more permanent employment to the factory staff, is essential if the canning industry is to be placed on a satisfactory basis.

I have briefly outlined the technical side of canning, but it would take me far longer than I have available to discuss this in detail, as there are so many ramifications. Perhaps it will be opportune to remind you that the research station at Campden, under the auspices of Bristol University, has now been running some seven or eight years with most successful results, issuing bulletins to the trade and making constant researches, and it is of inestimable value to the industry in this country. In writing this paper I have endeavoured to give some idea of the physical, chemical, and mechanical problems involved in an industry which is still in its infancy in this country, and I hope I have stimulated sufficient interest in the subject to encourage chemists and engineers to follow it up, with a view to the better development of the country's material resources, which have such great possibilities for the future with benefit to all concerned.

I am indebted for the loan of exhibits to The Metal Box, Ltd., and Arthur Holden & Sons, Ltd., for slides to British Canners, Ltd., the Campden Research Station, and Mather & Platt, Ltd., and for the film to the Mellingriffith Co., which have been much appreciated and I am sure have added to the interest of the paper.

THE PROTAL PROCESS FOR THE PROTECTION OF LIGHT ALLOYS

By J. COURNOT

The ideal method for the protection of metals against corrosion is evidently to make use of alloys that do not oxidize. So far as is known this has not yet been accomplished in the light aluminium alloys, and one must therefore turn to processes for protection of the surface. Here the efforts of investigators have been directed towards obtaining a film of alumina, as continuous as possible, on the surface of the metal. This production of alumina can be obtained by immersing the metal in suitable oxidizing reagents such as nitrates or bichromates, and above all, by electrolytic oxidation.

The Bengough process and its developments (B.P. Bengough, Stuart, 2.8.23; Ger. Pat. Vereinigte Aluminium Werke, 2.2.31 etc.) obtain this result by making use of acid solutions with a continuous or alternating current and the addition of reagents modifying the ionization of the bath. The Protal process protects aluminium and its alloys by a quite different method. The process of Oswald Bauer and Otto Vogel (30.12.23), the Pacz Patent (29.9.30), the patent of Jirotka and Consten (16.7.25), and the patent and researches of M. Charles Boulanger in 1927 have shown that it is possible to deposit on the surface of aluminium and its alloys, oxides of other metals which may give protection. The principle is as follows: If a strip of aluminium or an aluminium alloy is placed in a solution of an alkaline salt of a metal capable of forming two oxides, of which the higher oxide is soluble in alkali and the lower oxide insoluble, the nascent hydrogen produced by the action of the alkaline solution on the aluminium reduces the soluble higher oxide to the lower insoluble one, and this latter will be perfectly attached to the surface of the metallic strip.

In the course of these investigations it has been found that certain complex salts of the heavy metals can combine with aluminium, under suitable conditions, in a medium practically neutral (p_H~6). There will be formed on the surface of the metal a complex halogen compound including alumina from the metal and metallic oxides from the liquid. The Protal process makes use of similar reactions. There is a perfect contact between the metal and the protective film so formed. It will not be detached until the metal itself cracks when subjected to stamping or bending tests. The protection so obtained is particularly efficacious. It still seems necessary to complete the operation by a finish, with the object of filling up the pores which will inevitably be found in a protective surface whatever its nature is. It has been very justly remarked by Dr. Bengough that the best protective film will not inevitably give the best results when it is covered by a finish. The protective film must not only have a great capacity for adsorbing the finish, it must make a perfect union with the underlying metal that will be tightly bound and firmly attached. The industrial operation of "Protalizing" aluminium and its alloys is to immerse the object to be protected in a hot (100° C.) solution of the salts for about 40 minutes; there will be a liberation of gas which ceases when the process is completed. The objects treated are then rinsed and

the protective film impregnated with an appropriate finish: they can then successfully resist vigorous corrosives. The simplicity and low cost of the process should enable it, with the results already obtained, to take a considerable place in industry. It should even be used in industrial works more easily than the electrolytic processes, which have the following disadvantages: (*a*) the difficulty of "penetration" in very concave objects or objects inconveniently shaped, requiring a strong current, and the difficulty in treating assembled objects; (*b*) the incessant supervision of the voltage and other details of the process, a supervision requiring an intelligent and highly trained (and therefore expensive) staff; (*c*) the considerable cost of the electrolytic installation; (*d*) the ventilation necessary for the escape of the vapours and noxious gases given off; (*e*) the necessity of using different amperages according to the different alloys treated; (*f*) the high process cost, which makes the process only suitable for expensive objects and limits the size of the objects. In opposition to this, the Protal process chemical method of rust-proofing has the following features: (1) being effected by immersion, the Protal process is plainly applied; its throwing power is very strong. It does not require specialized staff; (2) the working strength of the processing solution can be tested by any one; (3) there are no noxious vapours; (4) a Protal plant includes only a tank that can be heated and a rinsing tank; (5) its cost price gives the possibility of applying it to any articles whatever their shape and their intrinsic value.

The tests carried out by official laboratories as well as by private ones show that the Protal process efficiently protects aluminium and magnesium alloys.* Besides, the results of the first French tests industrially carried out confirm the scientific results of the laboratories.

* Report on the tests affected by Centre d'Etudes Techniques du Bureau Veritas, Paris, on July 12, 1932.

L. B. HOLLIDAY & CO., LTD.

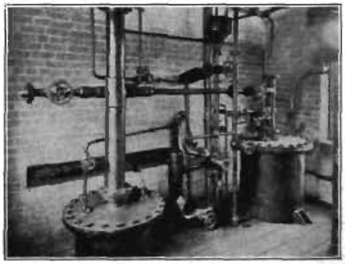
L. B. Holliday & Co., Ltd., the works of which we recently had the pleasure of visiting, is directly descended from the famous old tar-distilling and aniline dye-manufacturing firm of Read Holliday & Sons, the history of which is of such interest and so much a part of the history of the British dyestuffs industry that some account in these pages is by no means out of place.

Read Holliday & Sons was founded in 1830 by Mr. Read Holliday, who was then at the ripe age of 21. That such a young man should have embarked on a business enterprise becomes less surprising as one follows the activities of the Holliday family in later years, for they are always marked by resourcefulness, a resourcefulness which in the post-war years has led Major Holliday to build up, from a fresh start, a firm whose colours have become well known, and which has now achieved notability as the producer of this country's requirements of resorcine. But Mr. Read Holliday, if resourceful, was also a fortunate young man. He began business by distilling ammonia from the ammonia liquor of gas works, but within a few years had removed his premises from the original position in Leeds to the Turnbridge site at Huddersfield, the reason for the removal being that on this site he possessed some land on which the local gas works was "allowed" to dump its coal-tar! He made use of this coal-tar, first mixed with ashes as a fuel, and later as a source of naphtha and creosote. In 1848 he invented the naphtha lamp,

A view inside one of the colour sheds

which came to be used extensively all over the world and is yet not altogether extinct, whilst the creosote found a great demand for treating railway sleepers, and in course of time the residual pitch, at first thought to be useless, was exported to France for making briquettes.

In 1860 the firm was occupied in distilling coal-tar and producing nitro-benzol, toluol, aniline, and toluidine. The first colour patent, although not completed, was taken out in 1863 for the manufacture of spirit blues from rosaniline. Other patents followed in 1864 and 1865, and in the course of the next twenty years many more patents were taken out or acquired, which is indication enough that the lead of Perkin had found some following. Mr. Read Holliday died in 1889, but



Extraction plant used in resorcine production

his work was carried on by his sons, Thomas, Charles, John, Robert, and Edgar, the last of whom is known for his work in building up the dyestuffs industry in America, where he developed a branch of the firm. The firm became a limited company in 1890, with

what was then the very large capital of £200,000. Production of all types of colours went ahead, of Magenta, Spirit Blues, Soluble Blues, Nigrosines, Methyl Violets, Basic Greens, Bismarck Brown, Aniline Black, etc.: the hydrosulphite vat patent was acquired in 1871; the manufacture of sulphur dyes began in 1896. In the early years of this century extensive plant was put down for the manufacture of dimethylaniline, Auramine, Methylene Blue, etc. and branches of the firm were established as far afield as Melbourne, Leipzig, Vienna, Osaka, and Sydney.

During the war years the firm became absorbed in a larger combine, and the Turnbridge works are now part of the British Dyestuffs Corporation, but within a short time Major Holliday had been recalled from active service to undertake the manufacture of picric acid, and he established a factory not far distant from the old site. The buildings of this original factory are still to be seen, although they have since been added to considerably. As one passes down the "main road" of the factory one finds at the farther end the series of detached well-separated buildings in which the picric acid was made, and these buildings are still employed for processes requiring a degree of isolation. Picric acid manufacture gave place after the war to dyestuffs, and there is little need to comment here on the large range of colours now produced.

As we made our tour through the various buildings of the factory we were able to see the several stages of production, first the preparation of intermediates, and later the production of the actual dyes. The plant is well arranged, and it appeared that whatever operations were desired, whether they were methylations, sulphonations, carbonations, filtrations, etc., the plant could be brought quickly into operation in whatever sequence desired. We were able to follow, for instance, the process by which magenta is made, to see the dye in the mass, with its peculiar gold-like iridescence, and later in the dried state. Here there were reds, purples, greens, etc. being taken from the producing plant for the final treatment in stoves or vacuum dryers. There was throughout good organization and careful attention to details, and it was not hard to appreciate why these colours should now have such a high reputation amongst users.

The plant for the production of azo dyes was particularly of interest, and was a good example of the organization which can be brought into the chemical works operating many processes. The various plant and containers were arranged in some half-a-dozen tiers, connected by pipe-lines, allowing the materials to be taken from the top tier through successive processes until it reached the bottom tier in a finished condition.

Afterwards we visited the stores department, where hundreds of colours in many different packages were assembled ready for dispatch to the many parts of the world where the Holliday dyes are known. Finally we saw what was by no means the least interesting part of the factory, the resorcine plant. It is only very recently that the manufacture of resorcine has been taken up; yet production is now adequate to supply all the needs of the dyestuffs, plastics, and other industries in this country. The building in which final stages of production are carried out is a tall square structure, and the plant in it is of much interest. Resorcine possesses a very high degree of solubility, and the most difficult part of manufacture is to remove it from solution. Evaporating to dryness would be laborious and expensive, and difficult in the last stages owing to the syrupiness of the liquid. A process has therefore been developed, with the help of Prof. G. T. Morgan, by which the resorcine is first extracted from solution by ether, in which it is still more solvent, the ether being eventually evaporated. The plant has been ingeniously contrived so that it is continuous in operation, a relatively small amount of ether being used for the extraction, recovered, and used again. Our visit to this plant aided by preliminary explanation of a small-scale model in the research laboratory concluded a very interesting visit.

C. C. CONCANNON

Mr. C. C. Concannon, chief of the Chemistry Division of the United States Department of Commerce, is known for his charming personality to several chemists in this country who have been fortunate enough to enjoy his excellent hospitality during visits to America. Recently

he extended his circle of friends in England at the annual dinner of the Association of British Chemical Manufacturers, when he spoke on national industrial recovery in America.

Of Irish extraction, Mr. Concannon was born in Boston, Massachusetts, and graduated from Harvard University in 1911. For five years afterwards he was

connected with Brewer & Co., heavy chemical manufacturers of Worcester, Massachusetts, being concerned with the distribution of the company's products in the New England States. From 1916 until 1922 he was associated with the Takamine Laboratories in New York and took an active part in the management of the various enterprises controlled by Dr. Jokichi Takamine. In the course of this work Mr. Concannon travelled a good deal and spent two years in China and Japan.

His wide knowledge of the commercial side of the chemical industry has been used to good advantage in his present post of chief of the Chemistry Division of the U.S. Department of Commerce which he has held since 1922. He has become widely known in the United States as a lecturer and writer on subjects connected with the chemical industry and its commercial development. He is a member of the American Institute of Chemists and of the American Chemical Association. Apart altogether from his work on behalf of the chemical industry his personality has made him popular with many, and it is said that his presence at any gathering is bound to add to its gaiety.

CANADIAN MINING

According to the Dominion Bureau of Statistics at Ottawa, gold production in Canada during the first half of 1933 totalled 1,454,911 oz. worth $30,075,678, as compared with 1,496,078 fine oz. worth $30,926,683 produced during the first six months of 1932.

Selenium production in Canada during the first six months of 1933 amounted to 8600 lb., valued at $17,200. This metal, obtained as a by-product in copper refining, was produced for the first time in Canada early in 1931 at the plant of the Ontario Refining Company, Limited, Copper Cliff, Ontario.

It is reported that Eldorado Gold Mines, Limited, is receiving from the Ontario Government the equivalent of $50,000 per gramme for the radium already sold to the provincial authorities. Twenty-five needles have been delivered, and a sum of $16,000 is being paid for 325 milligrammes.

There are numerous deposits of natural sodium sulphate in Saskatchewan, some of which are now being developed for use by pulp and paper and nickel-copper refining industries. A new company, Metallics and Non-Metallics, Ltd., has recently obtained a charter to purchase the Ingebright sodium sulphate deposit north of Maple Creek. A full-sized drying plant is being erected and 100 tons of salt are shortly to be treated as a trial.

Ceramic bodies for electrical heating devices have been developed in the ceramic laboratories of the Department of Mines, Ottawa, and tests indicate that they are far superior in resistance to thermal shock to any ware on the market. Investigations have shown that excellent ceramic ware could be produced in any plant after a small amount of experimental work, making use of data presented in the report of investigations of the Ceramics Division for the years 1930 and 1931, which is now available.

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

Members are reminded of the following three events in the Society's programme:

Road Materials Conference. This conference will be held under the auspices of the Society on November 14 in connexion with the Public Works, Roads, and Transport Congress. Application for tickets should be made to the General Secretary.

Food Symposium. November 23 and 24.

Annual Chemical Dinner. The Annual Chemical Dinner is to be held in the Hotel Great Central on Tuesday, November 28. Application forms are now available and have been circulated.

LIVERPOOL SECTION

There was a very large attendance at the opening meeting of the session of the Liverpool Section which was held on Friday, October 27, in the Muspratt Lecture Theatre of Liverpool University. Mr. E. Gabriel Jones, the chairman of the Section, delivered an address entitled "The Chemist and the Public Health," in which he showed how the profession of chemistry played an important part in the preservation of health and life. The paper will be published in the JOURNAL at a later date.

A vote of thanks to Mr. Gabriel Jones was proposed by Dr. William Trantom, vice-chairman of the Section, and seconded by Prof. C. O. Bannister. Special reference was made to his work on the purity of Liverpool's water supply by Mr. Edwin Thompson, chairman of the Liverpool Water Committee.

The Leverhulme Chemistry Prize was then presented to Mr. T. G. Green of St. Helens, a student at the University of Liverpool. The Senior Prize of the Section was presented to Mr. D. N. Grindley, and the Junior Prize to Mr. C. E. Ryder, both students at the Central Technical School, the principal of which, Mr. J. Scholes Hague, was present.

The annual Secretary's Report was read by Mr. H. Raymond Feeny, and the Treasurer's Report by Mr. A. E. Findley. On the motion of the chairman, a very cordial vote of thanks was accorded to Mr. Feeny, the honorary secretary of the Section for the session 1932—3, who had been compelled to resign on account of business reasons.

NEWCASTLE SECTION

A general meeting of the Newcastle Section was held in the Chemical Lecture Theatre, Armstrong College, on Friday, October 27, when Prof. G. R. Clemo occupied the chair. The Saville-Shaw Medals of the Section, for the years 1931—32 and 1932—33, were presented to Mr. E. J. Mitchell, B.Sc., and Miss Edna Ferrell, B.Sc.

Miss Ferrell then read a paper on "Atomic Hydrogen." She mentioned that the isolation of the short-lived atomic form of hydrogen was effected by Woods in 1921. Since that time certain of its reactions had been studied, and in particular in the College, the reactions with

elements giving volatile hydrides. This work was now extended to those giving solid hydrides, and the present experiments described the reactions with the three alkali metals, *lithium, sodium*, and *potassium*, which form hydrides at ordinary temperatures, their formation being proved by (1) change in appearance of the metal, (2) action of water on the product, and (3) the reduction of carbon dioxide to the formic radical. Atomic hydrogen on associating to the hydrogen molecule gives out heat, but the present reactions did not arise from this cause as they progressed equally well when the reactants were maintained at ordinary temperatures and pressures.

In the absence of Mr. Mitchell, Mr. C. E. Pearson read his paper on the "Microstructure of the Aluminium-Silicon Alloys." He gave an account of the microstructure of the alloys of aluminium and silicon in the slowly-cooled and cast conditions, and also after modification with sodinm. It was pointed out that the impurities normally present in commercial grades of aluminium give rise to a number of independent micro-constituents in alloys made therefrom, which might sometimes have a deleterious effect on the properties of the alloys. Etching tests were further described by means of which the two compounds $FeAl_3$ and $CuAl_2$ might be identified.

After discussion upon both papers the chairman expressed the thanks of the members, and this was confirmed by acclamation.

INSTITUTE OF CHEMISTRY

A meeting of the Institute of Chemistry was held on October 28 at Exeter University, with Dr. E. Vanstone in the chair. Prof. J. J. Sudborough lectured to a large audience on "The Perishing of Paper in Indian Libraries." In many of the libraries in the plains of India, he said, a considerable proportion of the paper had undergone a process of perishing which appeared to exceed anything that had been observed in Enropean and American libraries. The perishing was very common with pure rag (cotton or linen) papers, although certain types of rag papers showed no signs of deterioration after 130 years. Such papers were certain coarse-fibred Eastern papers and certain English papers with watermarks, Whatman, Babston, Bigg, Budeen, Elgar, Curtiss, and others dating from 1796 to 1932. In hill-station libraries, such as at Simla and Ootacamund, the proportion of perished paper was much less. The nature of the perishing in the case of rag paper appeared to be a process of hydrolysis, rather than oxidation, as chemical examination revealed the presence of products with high copper-reducing values, probably hydrocelluloses. The perishing was probably due to over-bleaching, or the non-removal of the last traces of bleaching agent. The latter cause appears to have been more common before sodium thiosulphate was used for removing the excess of bleaching agent. The amounts of rosin and gelatin did not appear to have much effect on the durability of the paper, but excess of alum in sizing probably had a marked effect, and the non-removal of all the traces of acid was highly prejudicial to the keeping powers of the paper.

OBITUARY

FRANK GREVILLE WILLIAMS

The early history of the dyestuff industry is recalled by the death on October 13 last at the age of 74 of Mr. Frank Greville Williams, chairman of directors of the firm of Williams (Hounslow), Ltd., formerly known as Williams Bros. of Hounslow.

Mr. Frank Williams was the youngest and only surviving son of the late Charles H. Greville Williams, a Fellow of the Royal Society and a chemist of considerable distinction who in his early days was an assistant to W. H. Perkin (later Sir William Perkin) at the first dyestuff factory at Greenford. Greville Williams is known to science as the discoverer of the first member of the cyanine class of dyes, the later developments of which have had such an important influence upon modern photography, and also of the unsaturated hydrocarbon isoprene the polymerization of which to rubber was demonstrated much later by Tilden. After leaving the service of the Perkin firm, Greville Williams established at Brentford in the year 1868 the dyestuff works of Williams, Thomas & Dower, at which was manufactured most of the dyestuffs then known, Indulines, Magenta, Bismarck Brown, Tropæolines, etc. At this historic works Raphael Meldola and Dr. Otto N. Witt were engaged for a time as chemists, and it was there in 1875 that the latter discovered Chrysoidine and in conjunction with E. Thomas investigated the mechanism of the Induline reaction. Meldola subsequently joined the firm of Brooke, Simpson & Spiller, and later became Professor of Chemistry at the Finsbury Technical College, whilst his successor Witt became Professor of Chemistry at the Technische Hochschule, Berlin.

The firm of Williams, Thomas & Dower was liquidated in 1878, and in the following year the two elder sons of Greville Williams, Rupert and Lewis established a small dyestuff factory at Hounslow where with the help of some of the former employees of the Brentford works they continued the manufacture of most of the products previously made there. About four years later the Williams brothers were joined by Mr. Charles Ekin, a pharmaceutical chemist of Bath and a man of much ability, who however retired from the firm a few years later in order to become a partner in Savory & Moore, pharmaceutical chemists of Bond Street, London.

The youngest brother Frank entered the firm in about the year 1884 as an employee and became sole managing partner in 1903 after the death of his surviving brother Lewis. He retained the position of chairman until his death. Under his management the company, always conducted upon rather conservative lines, made continuous and regular progress, successfully weathering the difficult times through which the British dyestuff industry has passed. From very small beginnings with a capital of only a few hundred pounds the undertaking has grown to its present substantial position in the dyestuff world.

Mr. Frank Williams was a man of kindly, sympathetic, and generous disposition who was held in great respect and affection by his staff and workpeople.

He leaves a widow bnt no family.

ARTHUR G. GREEN

CORRESPONDENCE

FRICTION TESTS ON LUBRICATING OILS

SIR,—May I point out that in your report of the meeting of the Glasgow Section on October 6 (CHEM. & IND., Oct. 13, p. 818), you omitted the main point of my suggestion. This was that the resistance to the relative movement of two lubricated surfaces, under the conditions of the experiments described, consists of two quantities: resistance due to the interlocking of surface asperities (such as would occur with dry surfaces, though to a less extent) and resistance due to movement of the lubricant between the irregularities of the surfaces, resulting in a pumping action. The former will be the predominant factor at low temperatures and will increase with increased temperature up to a point where no sensibly closer approach of the surfaces can occur with a further reduction of viscosity. *The second quantity will decrease as the temperature* rises, owing to the reduced viscosity of the lubricant and these two opposing results of a rising temperature may give temperature-μ curves of the types obtained for mineral and vegetable oils, according to their relative magnitudes.

It is not suggested that fluid film conditions are *established*, thereby giving rise to a pumping action on the bearing as a whole.

I am, Sir, etc.,
ALFRED H. LOVELESS

Glasgow
Oct. 24, 1933

THE INDUCED OXIDATION OF LACTIC ACID BY ASCORBIC ACID AND THE CANCER PROBLEM

SIR,—Our researches on induced oxidation (Rec. trav. chim., 1929, **48**, 711—725, and the earlier publications mentioned there) have led us also to attempt to oxidize lactic acid. The purpose of this *investigation* (Chem. Weekblad, 1931, **28**, 337; 1933, **30**, 618) was to find a method by which it might be possible to oxidize in cancer tumours the lactic acid formed there in large quantities, which acid is regarded by several authors as injurious to the surrounding cells and will, perhaps, further the extension of the tumour.

Now we observe that, for instance, sodium sulphite and also phosphorus (dissolved in castor-oil) are able to induce the oxidation of lactic acid during their own oxidation. For the above-mentioned purpose, however, our experiments with glucuronic acid and especially those with ascorbic acid (vitamin-*C*) are promising. *In vitro*, a solution of lactic acid, the hydrogen ion concentration of which was brought to the desired value by means of phosphate, appeared to undergo a considerable oxidation in the presence of oxidizing ascorbic acid.

As vitamin-*C* is a substance not unknown in the human body (it is found in the adrenal cortex) and is being applied already as a remedy in connexion with its anti-scorbutic activity, the question arises whether application *per os* and/or by syringe could bring about salutary results in cases of cancer. Since the oxidation of the ascorbic acid is reversible, it is possible that in the cells this substance may act as an oxygen carrier. Of course, experiments with cancer cells cultivated in solutions and with tumours of mice will have to be made in the first place.

We are, Sirs, etc.,
W. P. JORISSEN
A. H. BELINFANTE

The University, Leiden, Holland
Oct., 1933

METRIC UNITS OF VOLUME

SIR,—(1) Since science hath not one country but all countries, any change of a term of universal application, for instance, so primordial an instance as "cubic *centimetre*," should be ratified by all nations, so that such term shall be universally used, universally understood, and be of identical significance. (2) At present, if I speak in Japan, in Germany, in France, in Brazil, etc., and mention the words "*cubic centimetre*," my listeners know of what I speak. But will they do so, or do they do so, if I use the novel word "*mil*"? Has anyone used the word "mil" (meaning cubic centimetre) at an International Congress? And if so has he been understood? What for instance does "deux milles mils" convey to a Frenchman? Perhaps he will proverbially remark "J'étais cent milles de là"! (3) The decision is not for the British or English speakers alone, but is one for all nations. There are International Congresses: let the matter be put before them before any novel term is accepted or stereotyped. (4) If a new word (*not mere local jargon*) *must* be introduced, let it be clear and non-identifiable with any second meaning in other languages, whether written or spoken. Gram or gramme is often used at any rate where water is concerned; for "c.c.," what is the matter with a fluid gram (cf. our ounce and fluid ounce)?

Are we to break away from the Science League of Nations as others have done from the Political? Incidentally, is it not time that we vulgarized metric notation in this land? Take 1,249—*this means nearly* twelve hundred and fifty, whilst 1·249 means nearly one and a quarter.

I am, Sir, etc.,
H. E. DURHAM

Dunelm, Hereford
Oct. 28, 1933

A WARNING TO CHEMISTS

SIR,—I was glad to see Dr. Dorée's letter in last week's issue of CHEMISTRY AND INDUSTRY. There should hardly be any need for me to say that I have given no authorization for my name to be used in any such circumstances. It is an old dodge for such men as the seafaring individuals referred to to give as reference the name of some one living at a distance. The man who called on me used the name of a well-known professor of chemistry in London, and also that of one of the officials of the Institute of Chemistry. I placed as much credence in his statements as did Dr. Dorée.

I am, Sir, etc.,
T. SLATER PRICE

Heriot-Watt College,
Edinburgh
Oct. 30, 1933

PERSONAL AND OTHER ITEMS

The University of London has awarded the degree of Sc. (Chemistry) to Mr. L. J. Burrage.

The University of Manchester has appointed Mr. W. F. Short, D.Sc., lecturer in organic chemistry.

The Medical Research Council has appointed Prof. E. P. Cathcart, F.R.S. to be chairman of the Industrial Health Research Board in succession to Sir Arnold T. Wilson, who has resigned on becoming a Member of Parliament. Prof. Cathcart is Regius Professor of Physiology in the University of Glasgow and was Gardiner Professor of Chemical Physiology from 1919 to 1928. The Council has also appointed Prof. Cyril Burt and Miss Hilda Martindale to be members of the Board in succession to Sir John Parsons, F.R.S., and Miss M. Ritson, who have retired in rotation.

Mr. H. Berry, B.Sc., has been appointed as from January 1, 1934, to the University of London Readership in Pharmaceutics tenable at the College of the Pharmaceutical Society of Great Britain. Since 1927 he has been head of the Department of Pharmacy at the Central Technical College, Birmingham.

We regret to announce the death on October 29 at the age of 68 of Sir Alexander Houston, F.R.S., Director of Water Examinations, Metropolitan Water Board, since 1905. Sir Alexander, who was educated at Merchiston Castle School, Edinburgh, and Edinburgh University, worked on a number of subjects connected with food supply and public health between 1893 and 1905. He was bacteriologist to the Royal Commission on Sewage Disposal, 1899—1905, and was bacteriologist to the Lincoln Corporation during the typhoid epidemic of 1907. He was created a K.B.E. in 1918 and C.V.O. in 1919, and was elected a Fellow of the Royal Society in 1931. In addition to many reports Sir Alexander was the author of several books dealing with water supply.

The consulting practice of the late Mr. C. H. Cribb, F.I.C., who died in June last, has been transferred to Mr. T. M. McLachlan, of 10A, Featherstone Buildings, High Holborn, London, W.C.1. Mr. McLachlan was associated with Mr. Cribb for many years, and has carried on the practice since his death.

Mr. Basil Marriott has joined the recently formed Copper Development Association as architectural advisor.

Sir Kenyon P. Vaughan-Morgan, vice-chairman of the Morgan Crucible Co., Ltd., left estate of the gross value £176,031, with net personalty £162,757.

The death is announced of Mr. F. W. Fletcher, governing director of Fletcher, Fletcher & Co., Ltd., manufacturing chemists of Holloway, London. Mr. Fletcher was well known for his work on pharmaceutical subjects, especially tinctures, and his process for the manufacture of hydrobromic acid was adopted in the British Pharmacopœia of 1885.

We regret to annonnce the death on October 10 of Mr. Edward Adlard, senior director of the old-established firm of Evans, Adlard & Co., Ltd., manufacturing filter papers, etc. at the Postlip Mills, Winchcombe, Cheltenham.

The death is announced, at the age of 37, of Mr. H. G. Belasco of Wolstanton who had been principal of the Longton Technical School since 1921. He had a distinguished academic career at the East London College, where he obtained the Neil Arnot Scholarship with bronze medal in chemistry.

We regret to learn of the death in Paris on October 29 of Prof. Léon Calmette, assistant director of the Pasteur Institute, and one of the leaders of medical research in France.

Proposed Change in the Law Concerning Foods

The Society has been asked to give evidence before the Departmental Committee on Food Law, and a memorandum is being prepared by the Food Group, and, after approval by Council, will be placed before the Committee. The duty of the Committee is to consider the desirability of altering the law relating to the composition and description of articles of food so as to enable definitions or standards to be prescribed, or declarations of composition to be required.

Industry in Wales

"*The Times*" *Trade and Engineering Supplement* of October 28 included a supplement on "Industrial Wales" which contains a number of excellent and authoritative articles on Welsh industries, including the coal and iron industries, tinplate production, copper and nickel refining, engineering, paper-making, the production of slates and other building materials, and chemical manufacture in North Wales. In view of the fact that next year's meeting of the Society is to be held in Cardiff, an article on "Chemical Industry in South Wales," contributed by Mr. E. A. Rudge, secretary of the South Wales Section, is of particular interest.

German Steel Industry Reorganization

The directors of the four leading steel manufacturing companies in Germany met recently and decided on a scheme of reorganization which will result in decentralization and reduction of capital. The companies concerned are Vereinigte Stahlwerke A.-G., Gelsenkirchener Bergwerks A.-G., Phoenix A.-G. für Bergbau und Hüttenbetrieb, and the Van der Zypen und Wissener Eisenhutten A.-G., which together are at present capitalized at about £60,000 (at par). The four companies are to be merged under the title of Vereinigte Stahlwerke A.-G., although technically the Gelsenkirchener Bergwerks will absorb the other three companies and take the name of Vereinigte Stahlwerke with headquarters at Düsseldorf with capital of Rm. 560,000,000 (£28,000,000 at par), sufficient to take over the entire properties of the other companies. The companies are to meet on November 29 to pass the necessary resolutions bringing the scheme into effect by an exchange of shares.

World Trade in 1933

A survey of world trade in the first half of 1933, published in *The Board of Trade Journal* shows that of 18 countries for which particulars are given only two, Japan and Australia, recorded increases of imports compared with 1932. The imports of the United Kingdom were 11% smaller. Six countries recorded increases in export values as compared with the first half of 1932,

Japan leading with an increase of 55%. The United Kingdom, Germany, and the U.S.A. showed decreases of 6·3%, 20·4%, and 19·9% respectively.

The Institution of Chemical Engineers

The report of the Board of Examiners on the 1933 Associate Membership Examination of the Institution of Chemical Engineers states that some of the answers received were of very high standard, but candidates continued to show a weakness in knowledge of materials of construction for ordinary conditions of service in contact with common corrosive agents.

The following candidates satisfied the examiners: E. S. Edmiston, J. W. Phipps, C. A. Smale, R. W. Sutton, W. J. Walker, J. H. Wood, W. L. Wood.

Application forms for the 1934 examination, together with a memorandum on "The Training of the Chemical Engineer," may now be obtained from the Honorary Registrar of the Institution, Abbey House, Westminster, London, S.W.1.

A New Tin Control Agreement

The International Tin Committee met recently in London and announced afterwards that the representatives of Bolivia, the Malay States, the Netherlands East Indies, Nigeria, and Siam had signed agreements for the continuance of control over the production and export of tin. Under the new scheme, which comes into operation on January 1, 1934, the agreed standard tonnages of production are: Bolivia, 46,490 tons metallic tin; Malay States, 71,940 t.; Netherlands East Indies, 36,330 t.; Nigeria, 10,890 t.; making a total of 165,650 t. of metallic tin. The representatives of these four agreed to export quotas fixed at not less than 40% of the standard tonnages, with an additional 4% during 1934. In the case of Siam the agreed export has been fixed at 9800 tons.

British Industries Fair

Advance bookings of space by exhibitors in the chemicals and druggists sundries sections for the 1934 British Industries Fair in February next, at Olympia, already exceed the corresponding total allotments at the 1933 Fair. So far 8105 sq. ft. have been applied for by the chemical industry, compared with 7818 sq. ft. occupied at the last Fair.

New I.C.I. Laboratories

Two new laboratories of Imperial Chemical Industries were opened on October 26 at Blackley, Manchester, one of them being designed to deal with wetting and stripping agents and other products auxiliary to dyestuffs, and the other with rubber and resins. The laboratories are to be used both for research and for customers' service; in the first, endeavours will be made to determine as precisely as possible the requirements of the textile trades and with such knowledge to attempt systematic preparation of materials with the required properties. This laboratory is well equipped for making colour tests on fabrics, for determining tensile strength of fabrics after dyeing, ascertaining the wetting power of solutions, etc. The rubber and resins laboratory contains equipment for experimental milling and mastication of crêpe and sheet rubber, for testing tensile strength and resistance to abrasion, and for investigating the "ageing" of rubber.

COMPANY NEWS

BOOTS PURE DRUG CO., LTD.

Early this year 1,000,000 £1 shares of the company were purchased from the United Drug Co. of America by a British group. The shares have now been divided into four of 5s. each, and dealings in the new denomination began on October 23.

STEWARTS AND LLOYDS, LTD.—COLVILLES, LTD.

An agreement has been concluded between Stewarts and Lloyds, Ltd., and Colvilles, Ltd., whereby the latter company will take over the steel plate business of Stewarts and Lloyds, Ltd., in Scotland and in export markets. Stewarts and Lloyds, Ltd., at present manufactures steel plates at its Clydesdale Works. It has on this works a modern universal plate mill which it has been decided to reconstruct for use as a blooming mill and transfer to the new works at Corby, Northamptonshire. Other steel making operations at the Clydesdale works will be continued. The agreement will come into operation at the end of this year.

BRITISH CELANESE, LTD.

The balance from the trading account of the company for the year ended July 1, 1933, amounts to £1,685,550, an increase of £213,658 compared with the previous year. The net balance is £612,824, compared with £499,718 last year. Debenture interest absorbs £251,749, whilst research, advertising, and additions to patents account for £117,340. The net profit is £237,872, or £111,444 more than last year.

BRITISH OXYGEN CO., LTD.

The company has decided to pay an interim dividend of 2½% less tax on the ordinary shares, an increase of ½% compared with last year. The dividend is payable on November 10 to shareholders registered on October 27.

GOODLASS WALL & LEAD INDUSTRIES, LTD.

The company has announced the payment on October 31 of a bonus of one week's pay to every employee who has been in the company's service since January 1 this year. It is stated that whilst trade prospects are not sufficiently stable to justify any step towards reinstatement of the reductions in salaries and wages put into force in 1931, the conditions during the first six months of this year have shown some improvement, and the directors have decided to make a bonus payment in respect of that period.

THE EASTERN CHEMICAL CO., LTD.

The report of the company for the year ended March 31, 1933, shows a trading loss of £3132, and after writing off £4014 for depreciation, the total loss is £7147. Although production and sales increased satisfactorily the report states that it was impossible to raise the prices of the company's acids in India to a remunerative level.

CHEMICAL BANK & TRUST CO. OF NEW YORK

The statement of the company shows total assets of the company as at September 30, 1933, of $393,030,040. The capital stands at $20,000,000 and surplus at $40,000,000, with individual profits of $7,147,390 and reserves for taxes, interest, etc. of $13,474,431.

MARKET REPORT

This Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid, Acetic, 40% tech.—£20 5s. per ton d/d address U.K. in casks.

Acid, Chromic.—10½d. per lb., less 2½% d/d U.K.

Acid, Hydrochloric.—Spot, 4s.—6s. per carboy d/d according to purity, strength, and locality.

Acid, Nitric 80° Tw.—Spot, £18—£25 per ton makers' works, according to district and quality.

Acid, Sulphuric.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., *Non-arsenical, £6 15s. per ton.*

Ammonia (Anhydrous).—Spot, 10d. per lb. d/d in cylinders.

Ammonium Bichromate.—8d. per lb., d/d U.K.

Bisulphite of Lime.—£6 10s. per ton, f.o.r. London, packages free.

Bleaching Powder, 35/37%.—Spot, £8 15s. per ton d/d station in casks, special terms for contracts.

Borax, Commercial.—Granulated, £15 10s. per ton; *Powder, £17* per ton. (For 1-ton lots and upwards, packed in 1-cwt. bags, carriage paid any station in *Great Britain.*)

Calcium Chloride, Solid, 70/75%.—Spot, £5 5s. per ton d/d station in drums.

Chrometan.—Crystals, 3¼d. per lb.; Liquor, £19 10s. per ton d/d U.K.

Chromium Oxide.—10½d. per lb., according to quantity, d/d U.K.

Methylated Spirits, 61 O.P.—Industrial, 1s. 8d.—2s. 3d. per gal.; Pyridinized Industrial, 1s. 10d.—2s. 5d. per gal.; Mineralized, 2s. 9d.—3s. 3d. per gal. 64 O.P. 1d. extra in all cases. Prices according to quantity.

Nickel Sulphate.—£49 per ton d/d.

Nickel Ammon. Sulphate.—£49 per ton d/d.

Potash, Caustic.—£30—£33 per ton. Potass. Bichromate crystals and granular.—5d. per lb., net d/d U.K., *for spot. Discount according to quantity.* Ground, 5⅜d. per lb.

Potassinm Chromate.—6½d. per lb., d/d U.K.

Sal ammoniac, Firsts lump.—Spot, £42 17s. 6d. per ton d/d address in barrels. Chloride of Ammonia.—£37—£45 per ton, carr. paid.

Salt Cake, unground.—Spot, £3 15s. per ton d/d station in bulk.

Soda Ash, 58° E.—Spot, £5 17s. 6d. per ton, f.o.r. in bags, special terms for contracts.

Soda, Caustic, solid 76/77° E.—Spot, £14 5s. per ton d/d station in drums, special terms for contracts.

Soda crystals.—Spot, £5—£5 5s. per ton d/d station or ex depôt in 2-cwt. bags.

Sod. Acetate 97/98%.—£21 per ton. Sod. Bicarbonate (refined).—Spot, £10 10s. per ton d/d station in bags. Sod. Bichromate Crystals, Cake, and Powder.—4d. per lb., net d/d U.K., discount according to quantity. Anhydrous 5d. per lb. Sod. Bisulphite Powder 60/62%.—£16 10s. per ton delivered, 1-cwt. iron drums for home trade.

Sodium Chromate.—3⅞d. per lb., d/d U.K.

Sod. Phosphate.—£12 10s. per ton, f.o.r. London, casks free. Sod. Silicate 140° Tw.—Spot, £8 5s. per ton d/d station, returnable drums. Sod. Sulphate (Glauber's Salt).—Spot, £4 2s. 6d. per ton d/d. Sod. Sulphide solid, 60/62%.—Spot, £10 15s. per ton, d/d in drums. Crystals, 30/32%.—Spot, £8 per ton, d/d in casks. Sod. Sulphite, Pea Cryst.—Spot, £13 10s. per ton, d/d station in kegs; Commercial.—Spot, £9 10s. per ton, d/d station in bags.

RUBBER CHEMICALS

Antimony Sulphide.—Golden—6¼d.—1s. 1½d. per lb., according to quality. Crimson.—1s. 3d.—1s. 5d. per lb., according to quality.

Arsenic Sulphide, Yellow.—1s. 5d.—1s. 7d. per lb.

Barytes.—£7 10s.—£9 per ton, according to quality.

Cadmium Sulphide.—2s. 8d.—3s. per lb.

Carbon Bisulphide.—£30—£32 per ton, according to quantity, drums extra.

Carbon Black.—3⅞d.—5d. per lb., ex wharf.

Carbon Tetrachloride.—£41—£46 per ton, according to quantity, drums extra.

Chromium Oxide, Green.—1s. 2d. per lb.

Diphenylguanidine.—2s. 2d. per lb.

India-rubber Substitutes, White.—4¼d.—4⅝d. per lb. Dark.—3½d.—4¼d. per lb.

Lamp Black.—£45—£48 per ton.

Lead Hyposulphite.—9d. per lb.

Lithopone, 30%.—£17 10s.—£18 per ton.

Mineral Rubber "Rupron."—£18 10s. per ton.

Piperidine Rubber Accelerators.—P.P.D.—10s. 6d.—11s. 6d. per lb.; Z.P.D.—7s.—7s. 6d. per lb.; L.P.D.—6s. 6d.—7s. per lb.; P.T.D.—9s. 8d.—10s. 4d. per lb.; C.P.D.—8s. 3d.—8s. 10d. per lb.; S.P.D.—8s. 1d.—8s. 7d. per lb.; P.T.M.—11s. 6d.—12s. 6d. per lb.

Sulphur.—*£11 10s.* per ton. *Sulphur Precip.* B.P.—£55—£60 per ton. Sulphur Precip. Comm.—£50—£55 per ton.

Sulphur Chloride.—5d.—7d. per lb., according to quantity.

Vermilion, pale or deep.—4s. 3d.—4s. 5d. per lb.

Zinc Sulphide.—11d.—1s. per lb., according to quality.

WOOD DISTILLATION PRODUCTS

Acetate of Lime.—Brown, £8 15s.—£9 per ton. Grey, £14—£16 per ton. Liquor, Brown, 30° Tw., 6d. per gal.

Amyl Acetate, technical.—95s.—110s. per cwt.

Charcoal.—£6—£11 per ton, according to grade and locality.

Methyl Acetone, 40/50%.—£50—£52 per ton.

Wood Naphtha.—Miscible, 3s.—4s. per gal. Solvent, 3s. 9d.—4s. 9d. per gal.

Wood Tar.—£2 10s.—£6 per ton.

Wood Creosote.—6d.—2s. per gal.

TAR PRODUCTS

Acid Carbolic.—Crystals.—9d.—10d. per lb. Crude 60's, 2s. 5d.—2s. 6d. per gal.

Acid Cresylic, 99/100.—1s. 6d.—1s. 9d. per gal. Refined, 1s. 8d.—1s. 9d. per gal. Pale, 98%, 1s. 4d.—1s. 5d. per gal. 95%, 11d.—11½d. per gal. Dark, 10d. per gal.

Anthracene Oil, Strained, 4½d. per gal.

Benzole.—Prices at works: Crude, 9d.—9½d. per gal.; Standard motor, 1s. 4d.—1s. 4½d. per gal.; 90%, 1s. 5d.—1s. 6d. per gal.; Pure, 1s. 7½d.—1s. 8d. per gal.

Creosote.—B.S.I. specification, 3d.—3½d. per gal., d/d. Heavy—4d. per gal.

Naphtha.—Solvent, 90/160, 1s. 4d.—1s. 5d. per gal. Solvent, 95/160, 1s. 8d. per gal. Solvent 90/190, 11d.—1s. 1d. per gal.

Naphthalene.—Purified crystals, £9 15s. per ton in bags. Crude, Hot Pressed, £6 5s. per ton.

Pitch, medium, soft.—77s. 6d.—80s. per ton, in bulk at makers' works.

Pyridine.—90/140—4s. 6d.—5s. 6d. per gal.; 90/180—2s.—2s. 3d. per gal.

Toluole.—90%, 2s. 7d.—2s. 8d. per gal. Pure, 3s. per gal.

Xylol.—2s. 6d.—2s. 7d. per gal. Pure, 2s. 8d.—2s. 9d.

PHARMACEUTICAL AND PHOTOGRAPHIC MATERIALS

Acid, Acetic, Pure 80%.—£39 5s. per ton d/d address U.K. in casks.

Acid, Acetyl Salicylic.—2s. 9d.—2s. 11d. per lb., according to quantity.

Acid, Benzoic, B.P.—1s. 9d.—1s. 11d. per lb. Solely ex Gum.—1s. 3d.—1s. 6d. per oz.; 50-oz. lots, 1s. 3d. per oz.

Acid, Boric, B.P.—Cryst., £35 10s. per ton. Powder, £36 10s. per ton. Ex-Fine Powder, £38 10s. per ton. For 1-ton lots and upwards, packed in 1-cwt. bags, carriage paid any station in Great Britain.

Acid, Camphoric.—19s.—21s. per lb.

Acid, Citric.—9½d. per lb. Less 5%.

Acid, Gallic.—2s. 9d. per lb. for pure crystal in 1-cwt. lots.

Acid, Molybdic.—5s. 3d.—5s. 9d. per lb., according to quantity.

Acid, Pyrogallic. Cryst.—6s. 9d. per lb. for 1-cwt. lots. Resublimed.—8s. 6d. per lb. for 28-lb. lots d/d.

Acid, Salicylic.—B.P. pulv., 1s. 7d.—1s. 10d. per lb. Technical, 1s. 2d.—1s. 4d. per lb.

Acid, Tannic, B.P.—3s. 9d. per lb.

Acid, Tartaric.—1s. 0½d. per lb. Less 5%.

Acetanilide.—1s. 5d. per lb.

Ammon. Benzoate.—3s. 3d.—3s. 9d. per lb.

Ammonium Hippurate.—19s. 6d.—23s. 6d. per lb.

Ammonium Iodide.—10s. per lb.

Ammonium Molybdate.—5s.—5s. 6d. per lb., according to quantity.

Argent. Nitras, Crystal.—1s. 1d. per oz.

Arsenic Iodide.—22s. 6d.—25s. per lb.

Benzonaphthol.—3s. 3d.—3s. 9d. per lb.

Berberine, Hydrochloride.—5s. 6d.—6s. per oz.; Sulphate, 5s. 6d.—6s. per oz.

Bismuth Salts.—Carbonate, 7s. 5d. per lb.; Citrate, 10s. per lb.; Nitrate cryst.), 5s. 2d. per lb.; Oxide, 11s. 7d. per lb.; Salicylate, 8s. 4d. per lb.; Subchloride, 11s. 4d. per lb.; Subgallate, 7s. 11d. per lb.; Subnitrate, 6s. 7d. per lb. Above for cwt. lots. Extra and reduced prices for smaller and larger quantities respectively. Liquor Bismuthi, P.P., in W. Qts.—1s. 1½d. per lb.; 6 W. Qts.—11d. per lb.; 12 W. Qts.—9½d. per lb.; 36 W. Qts.—9d. per lb.

Borax, B.P.—Crystal, £24 10s. per ton. Powder, £25 per ton. For 1-ton lots and upwards, packed in 1-cwt. bags, carr. paid any station in Great Britain.

Bromides, B.P.—Ammonium.—1s. 10d. per lb. Potassium.—1s. 7d. per lb. Sodium.—1s. 9d. per lb. Prices for 1-cwt. lots.

Calcium Hippurate.—26s.—30s. per lb.

Calcium Iodide.—20s. per lb.

Calcium Lactate, B.P.—1s. 2d.—1s. 4d. per lb., according to quantity.

Camphor.—Refined flowers, 3s. 1d.—3s. 2d. per lb. Transparent tablets, 3s. 4d.—3s. 6d. per lb., according to quantity; also special contract prices.

Chloroform.—2s. 3d.—2s. 8d. per lb.

Cinchophen.—11s. 6d.—12s. 6d. per lb.

Cocaine, Alkaloid and Citrate.—For export.—29s. 10d.—31s. 7d. per oz. Hydrochloride and Nitrate 27s. 1d.—28s. 11d. per oz.

Ephedrine hydrochloride.—5s. 6d.—6s. per oz.

Ergosterol.—2s. 6d. per gm.

Hexamine.—2s. 4d.—2s. 6d. per lb., according to quantity.

Hippuric Acid.—17s. 6d.—21s. 6d. per lb.

Hydrogen Peroxide (12 vols.).—1s. 4d. per gal., f.o.r. makers' works, naked. B.P.—10 vols., 2s.—2s. 3d per gal.; 20 vols., 3s. per gal.

Hypophosphites.—Calcium, 2s. 9d.—3s. 2d. per lb. Potassium.—3s. 4d.—3s. 9d. per lb. Sodium 2s. 11d.—3s. 4d. per lb.

Iodine Resub., B.P.—9s.—11s. per lb.

Iodoform, B.P., Cryst., Precip. or Powder.—10s. 9d.—13s. 7d. per lb.

Iron Ammon. Citrate.—B.P.—1s. 9d. per lb. for 28-lb. lots. Green, 2s. 5d. per lb. (list price).

Iron Perchloride.—18s.—20s. per cwt., according to quantity.

Iron Quinine Citrate, B.P.—10½d.—11¼d. per oz., according to quantity.

Lithium Carbonate, B.P., 1914.—5s. 4d. per lb.

Lithium Chloride, Cryst.—8s. 3d. per lb.

Lithium Citrate.—5s. 3d. per lb. Powder.—5s. 6d per lb.

Lithium Hippurate.—18s. 6d.—22s. 6d. per lb.

Lithium Iodide.—20s. 6d.—21s. 6d. per lb.

Magnesium Carbonate.—Light, 28s. per cwt.

Magnesium, Oxide.—Light, 70s. per cwt.; Heav 1s. 8d. per lb.; in quantity lower.

Menthol.—A.B.R., recryst., B.P., 15s. per lb. net Synthetic, 8s. 6d.—12s. per lb. Synthetic detache crystals, 8s. 6d.—10s. 6d. per lb., according to quan tity; Liquid (95%), 8s. 6d. per lb.

Mercurials, B.P.—Red oxide crystals, 5s. 10d.—5s. 11d per lb.; Levig, 5s. 4d.—5s. 5d. per lb.; Corrosiv sublimate, Lump, 4s.—4s. 1d. per lb.; Powder 3s. 8d.—3s. 9d. per lb.; White precip., Lump 4s. 9d.—4s. 10d. per lb.; Powder, 4s. 11d.—5s. pe lb.; Calomel, 4s. 9d.—4s. 10d. per lb. Yello Oxide, 5s. 2d.—5s. 3d. per lb.; Persulph., B.P.C. 4s. 11d.—5s. per lb.; Sulph. nig., 4s. 10d.—4s. 11d per lb. Special prices for larger quantities.

Mercury, Benzoate.—8s. 3d. per lb.; Cyanide, 12s. 7d.—13s. 1d. per lb.; Oleate (5%), 1s. 11d.—2s. 2d. pe lb.; (10%), 2s. 9d.—3s. per lb.; (20%), 3s. 9d.—4s. per lb. Protonitras, 6s. 9d. per lb.; Proto sulphate, 7s. 3d. per lb.; Subsulphate flav., 7s. 1d per lb.

Methyl Salicylate.—1s. 4½d.—1s. 6½d. per lb.

Paraformaldéhyde.—1s. 3d.—1s. 5d. per lb.

Paraldehyde.—1s. 3½d.—1s. 9d. per lb., according t quantity.

Phenacetin.—4s.—4s. 6d. per lb.

Phenolphthalein.—4s. 5d.—5s. 8d. per lb.
Potass. Bitartrate.—99/100% (Cream of Tartar), 80s. per cwt., less 2½%.
Potass. Citrate.—B.P., 1s. 7d. per lb. for 28-lb. lots.
Potass Ferricyanide.—1s. 7½d. per lb., in 125-lb. kegs.
Potass. Iodide, B.P.—8s. 3d.—10s. 3d. per lb., according to quantity.
Potass. Permanganate.—8¼d. per lb. for 1-ton lots.
Potass. Metabisulphite.—50s. per cwt. d/d London, kegs free.
Potassium Hippurate.—26s.—30s. per lb.
Quinine Sulphate.—2s. per oz., for 100-oz. tins; tins free.
Saccharin.—37s. 6d. per lb., and lower in quantity.
Salicin.—15s.—16s. per lb., according to quantity.
Santonin, B.P.—28s. per oz.
Seidlitz powder (pulv.).—55s.—58s. 9d. per cwt.
Silver Nitrate.—1s. 3¼d. per oz. for quantity. Sticks, 2d. per oz. extra.
Sod. Barbitonum.—13s.—15s. per lb.
Sod. Benzoate, B.P.—1s. 9d.—2s. 3d. per lb., according to quantity.
Sod. Citrate, B.P.C., 1911.—1s. 4d. per lb. B.P.C., 1932, and U.S.P.—1s. 8d. per lb. for 28-lb. lots.
Sodium Hippurate.—23s. 6d.—27s. 6d. per lb.
Sod. Hyposulphite.—Photographic, £15 per ton d/d consignee's station, in 1-cwt. kegs.
Sodium Iodide, B.P.—8s. 6d.—10s. 6d. per lb.
Sod. Nitroprusside.—16s. per lb.
Sod. Potass. Tartrate (Rochelle Salt).—65s. per cwt. net for 1-ton lots. Crystals, 2s. 6d. per cwt. extra.
Sod. Salicylate.—Powder, 2s.—2s. 8d. per lb. Crystal, 2s. 1d.—2s. 9d. per lb.
Sod. Sulphide.—Pure recryst., 10d.—1s. 2d. per lb.
Sod. Sulphide anhydrous.—£23—£25 per ton, according to quantity, d/d U.K.
Tartar Emetic, B.P.—3s. 9d.—4s. 6d. per lb.
Terpine hydrate.—1s. 2d.—1s. 5d. per lb.
Thymol, Puriss.—5s. 9d.—6s. 6d. per lb., according to quantity. Natural.—12s. per lb.
Zinc Stearate.—1s. 3d.—1s. 8d. per lb.

PERFUMERY CHEMICALS

Acetophenone.—7s. per lb.
Aubepine (*ex Anethole*).—8s. per lb.
Amyl Acetate.—2s. 3d. per lb. Amyl Butyrate.—4s. per lb. Amyl Cinnamic Aldehyde.—8s. 3d. per lb. Amyl Salicylate.—2s. 9d. per lb. Anethol, 21/22° C., 4s. 9d. per lb.
Benzaldehyde free from Chlorine.—2s. 9d. per lb.
Benzyl Acetate from Chlorine-free Benzyl Alcohol.—2s. per lb. *Benzyl Alcohol free from Chlorine.*—2s. per lb. Benzyl Benzoate, 2s. 3d. per lb.
Cinnamic Aldehyde.—Natural, 12s. 3d. per lb.
Citronellol.—8s. 6d. per lb.
Citral.—7s. per lb.
Coumarin.—15s. per lb.
Ethyl Cinnamate.—8s. 6d. per lb.
Ethyl Phthalate.—2s. 6d. per lb.
Eugenol.—7s. 3d. per lb. Geraniol (Palmarosa).—17s. per lb. Geraniol.—6s. 6d.—11s. per lb. Heliotropine.—6s. per lb. Iso Eugenol.—8s. 6d. per lb. Linalol.—(*ex Bois de Rose*), 6s. 3d. per lb.—(*ex Shui Oil*) 5s. 6d. per lb. Linalyl Acetate.—(*ex Bois de Rose*), 7s. 6d. per lb.—(*ex Shui Oil*) 6s. 6d. per lb.
Methyl Anthranilate.—9s. per lb.
Methyl Benzoate.—4s. 6d. per lb.
Musk Ketone.—33s. per lb.
Musk Xylol.—8s. per lb.
Nerolin.—5s. per lb.
Phenyl Ethyl Acetate.—10s. per lb.
Phenyl Ethyl Alcohol.—8s. 6d. per lb.
Rhodinol.—60s. per lb. Safrol.—1s. 6d. per lb. Terpineol.—2s. per lb. Vanillin (*ex Clove Oil*).—16s.—18s. per lb.—(*ex Guaiacol*)—14s. 3d.—16s. 3d. per lb.

ESSENTIAL OILS

Almond.—Foreign S.P.A., 9s. per lb. Anise.—2s. 1d. per lb. Bergamot.—7s. per lb. Bourbon Geranium.—24s. 3d. per lb.
Camphor.—Brown, 75s. per cwt.—White, 95s. per cwt. Cananga, Java, 10s. 6d. per lb. Cinnamon Oil, Ceylon.—3s. 3d. per lb. Cassia, 80/85%, 4s. 3d. per lb.
Citronella Oil.—Java, 2s. 4d. per lb. Ceylon, 2s. 3d. per lb. Clove.—90/92% English, 4s. 3d. per lb.
Eucalyptus, Australian B.P., 70/75%.—1s. 2d. per lb. Lavender.—Mont Blanc, 38/40%.—16s. per lb. Lemon.—5s. per lb. Lemongrass.—4s. per lb. Orange, Sweet.—6s. 6d. per lb. Otto of Rose.—Anatolian, 33s. per oz.; Bulgarian, 45s. per oz. Palma Rosa, 8s. 6d. per lb.
Peppermint.—Japanese, 5s. per lb. Wayne County, 13s. 6d. per lb. Petitgrain.—5s. 6d. per lb.
Sandalwood, Mysore.—30s. per lb. 90/92%, 20s. 6d. per lb. Australian, B.P. and French Codex, 92/95%, 15s. 6d. per lb.

INTERMEDIATES

Items marked thus * d/d buyers' works.

*Acid, Benzoic, 1914 B.P. *ex Toluol*.—1s. 9½d. per lb. in casks.
*Acid Gamma.—Spot, 4s. per lb., 100%.
*Acid H.—Spot, 2s. 4½d per lb., 100%.
*Acid Neville and Winther.—Spot, 3s. per lb., 100%.
*Acid Sulphanilic, 8d. per lb.
*Aniline Oil, spot, 8d. per lb., drums extra.
*Aniline Salts, spot, 8d. per lb., casks free.
*Benzaldehyde, spot, 1s. 8d. per lb., packages extra.
*Benzidine Base.—Spot, 2s. 5d. per lb., 100%.
o-Cresol 30/31° C.—£2 6s. 5d. per cwt. in 1-ton lots.
m-Cresol 98/100%.—2s. 3d. per lb., in ton lots.
p-Cresol 34.5° C.—1s. 9d. per lb., in ton lots.
Dichloraniline.—2s. 3d. per lb.
*Dimethylaniline.—Spot, 1s. 6d. per lb., packages extra.
Dinitrobenzene.—8d. per lb.
Dinitrotoluene 48/50° C.—8½d. per lb. 66/68° C.—10d. per lb.
*Diphenylamine.—Spot, 2s. per lb.
*α-Naphthol.—Spot, 2s. 4d. per lb.
*β-Naphthol.—Spot, £78 15s. per ton, in paper bags; £79 15s. per ton in casks, in 1-ton lots.
*α-Naphthylamine.—Spot, 11½d. per lb.
*β-Naphthylamine.—Spot, 2s. 9d. per lb.
o-Nitraniline.—5s. 10d. per lb.
**m*-Nitraniline.—2s. 7d. per lb.
**p*-Nitraniline.—Spot, 1s. 8d.—2s. 1d. per lb.
*Nitrobenzene.—Spot, 4½d. per lb., in 90-gallon drums, drums extra. 1-ton lots.
Nitronaphthalene.—9d. per lb.
*Sodium Naphthionate.—Spot, 1s. 9d. per lb., 100%.
**p*-Toluidine.—Spot, 1s. 11d. per lb.
**o*-Toluidine.—Spot, 9½d. per lb., drums extra.
m-Xylidine acetate, 4s. 6d. per lb., 100%.

PATENT LIST

The following is a list of complete specifications of chemical interest which are open for inspection under Section 91 (4) (a) of the Patent Acts. Printed copies are not available, but photographic copies may be obtained at a charge of 8d per page (minimum 1s) from the Patent Office, Chancery Lane, W.C.2.

I. 3350 (1933). Houdry Process Corp. Regeneration of contact masses.

11,082 (1933). Jacquemotte. Separating dusts from gases.

II. 10,717 (1933). I. G. Farbenind. *See* VII.

III. 9574 (1933). Röhm & Hass Co. Preparation of lactones.

9752 (1933). Kali-Chemie A.-G. Production of thiocyanates of aromatic quaternary ammonium bases.

10,466–7 (1933). Wacker Ges. f. Elektrochem. Ind. Manufacture of 3-methylalpentane and 3-methylolpentane.

10,959–61 (1933). I. G. Farbenind. Manufacture of carbazole compounds.

11,298 (1933). Brit. Celanese, Ltd. Carrying out the Friedel–Crafts reaction.

11,299 (1933). Brit. Celanese, Ltd. Production of vinyl compounds and compositions containing them.

11,303 (1933). Brit. Celanese, Ltd. Manufacture of organic compounds.

IV. 10,804 (1933). Soc. Chem. Ind. in Basle. Manufacture of azo-dyestuffs.

10,937 (1933). I. G. Farbenind. Manufacture of azo-dyestuffs.

11,103 (1933). I. G. Farbenind. Manufacture of dyestuffs of the gallocyanine series.

V. 10,805 (1933). I. G. Farbenind. Improving cellulose derivatives.

11,044–5 (1933). Brit. Celanese, Ltd Cellulosic compositions.

27,542 (1933). Brit. Celanese, Ltd. Compositions and articles containing cellulose derivatives.

VII. 10,717 (1933). I. G. Farbenind. Separation of carbonic acid from gases.

VIII. 10,531 (1933). Jenaer Glaswerk. Glass-resisting metal vapours.

IX. 14,063 (1933). Geigy A.-G. Materials for construction of roads.

10,926 (1933). Hallenberg. *See* XI.

11,140–1 (1933). Hüttemann. Making light-weight heat-insulating blocks.

X. 8547 (1933). Minerals Separation, Ltd. Flotation concentration of minerals.

9734 (1933). Heraeus Vacuumschmelze A.-G. Sintered hard alloys.

11,158 (1933). Weber & Co. Hardening steels.

13,236 (1933). Kinzoku Zairyo Kenkyusho. Alloys.

XI. 10,926 (1933). Hallenberg. Insulating plates, wall-covering material, etc.

XIII. 4187–8 (1933). Staedtler. Making writing and marking leads.

11,042–3 (1933). Brit. Celanese, Ltd. Synthetic resins.

11,169 (1933). Du Pont de Nemours & Co. Manufacture of modified polyhydric alcohol-polybasic acid resins and coating and moulding compositions.

11,201 (1933). Brit. Celanese, Ltd. Production of plastic materials.

11,300 (1933). Brit. Celanese, Ltd. Manufacture of plastic compositions.

11,302 (1933). Brit. Celanese, Ltd. Synthetic resins and compositions containing them.

XIV. *36,299 (1932). Goodyear Tire & Rubber Co. Vulcanizing rubber and accelerators therefor.*

11,360–2 (1933). I. G. Farbenind. Manufacture of rubber derivatives.

XV. 11,372 (1933). Magyar Ruggyantaárugyár Rész. Leather imitations.

XX. 10,958 (1933). Georgiou. Manufacture of a substance for treatment of malignant tumours, in particular, cancer.

11,109 (1933). I. G. Farbenind. Manufacture of alkyl-mercury-mercapto compounds.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has received the following inquiries for British goods. British firms may obtain further information by applying to the Department and stating the specific number. *Australia :* Vitreous resistances (A.Y. 12,042). *Poland* . Aniline dyes and chemicals for the textile trade (464). *Spain :* Colours and aniline dyes (465). *United States :* Washed metal (G.Y. 13,075).

Key Industries

Representations have been made to the Board of Trade under Section 10 (5) of the Finance Act, 1926, regarding aminoguanidine sulphate and butylacetyl ricinoleate. Under Section 10 (5) of the Finance Act, 1926, the Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, an article that is not made in any part of the Dominions in quantities which are substantial, having regard to the consumption, and of which there is no reasonable probability that the article will within a reasonable period be made in such substantial quantities. Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1, before November 24, 1933.

A New Refrigerating Plant

The current issue of the *Sulzer Technical Review* No. 3, 1933, contains an article on the new Sulzer Frigorotor, a refrigerating plant which has lately been brought on the market and is intended for small and medium-sized industrial plants (14,000–240,000 B.Th.U. per hour) where the cold is led from a central refrigerating unit to various points of use. It consists of a rotary compressor, a condenser, and an evaporator, which are fitted together in one block together with other necessary parts to form a compact, self-contained unit. The article contains a number of excellent photographic illustrations and descriptive diagrams of the new plant.

Welding

The October number of *The Welder*, published by Messrs. Murex Welding Processes, Ltd., contains an informative article by Dipl.-Ing. Otto Bondy of Berlin on " Structural Steel Welding in Germany," and another useful article, by E. C. Rollason, M.Sc., discusses the causes of weld decay.